

Module Manual

Master of Science (M.Sc.) Civil Engineering

Cohort: Winter Term 2020 Updated: 31st May 2023

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Program description

Content

Civil engineering deals with the erection of buildings of all kind, in particular of structures like bridges and tunnels, structures in hydraulic engineering, water supply, waste and waste water disposal, harbour construction, streets, hall construction, as well as industrial and housing construction, including refurbishment. The master program civil engineering gives graduates the qualification to process difficult projects in the construction practice, including the necessary competences in business and management. Buildings arise by the cooperation of owners, planning offices, contractors, environment, politicians and society. Civil engineering is located in the field between technical and economic constraint, political will and legal conditions. The master program prepares for that. The master program also opens the way to doctoral studies and successful research activities, assuming a sufficient diploma.

The master program civil engineering is associated with the bachelor program "Bau- und Umweltingenieurwesen" and "Allgemeine Ingenieurwissenschaften Vertiefung Bauingenieurwesen" of the University of Technology Hamburg in the sense of a consecutive course of studies. Possible entries from other bachelor programs are based on a catalog of requirements, described in the document "Specific Requirements for the Master Program Civil Engineering".

Career prospects

The graduates of the master program civil engineering are prepared for a leading professional activity in planning offices, at building contractors, building authorities, owners of major immovables and infrastructure, producers of building products, material testing institutions and in research facilities. It aims at activities in extensive and difficult projects, or in research and development. In Germany a great demand exists at this time for civil engineers in particular with good knowledge in structural engineering. The master program is based on this demand.

Learning target

The graduates of the master program civil engineering gain the specialist knowledge and the methods, to plan and erect new buildings, in particular concrete structures, steel structures, structures in water engineering, in foundation engineering, in water supply, waste and waste water disposal, including refurbishment of existing structures. This incorporates the realization of necessary preliminary investigations, the design of structural elements, the development of all necessary proofs and the project management.

The graduates of the master program are able to transfer the acquired knowledge in engineering, mathematics and natural sciences to practical applications and to analyze and solve problems on a scientific basis, even if these are unusual or incompletely defined and comprise complex specifications. The graduates are able to successfully work on research projects in the field of civil engineering. Therefore a comprehensive understanding of the underlying processes and the ability to model and calculate such processes, e.g. with Finite Elements Methods, are necessary.

The graduates for this purpose gain the skills to experimentally determine the necessary properties of soil, materials and components and to deal with construction-specific program systems to calculate mechanical behavior, the hydraulics of systems as well as other physical-chemical processes. They are enabled to work on problems of civil engineering and related disciplines on one's own. They are able to use methods needed for the solution of technical problems and planning procedures. They are able to use new findings in a critical way and to improve methods and new developments.

The graduates can communicate on advanced contents and problems of civil engineering with specialists and the laity. They are able to present their methods and the results of their work in writing and verbally in a comprehensive way. The graduates in addition learn to work on problems in a team in a purposeful way, and to document and present their methods and results understandably with up-to-date presentation methods to other persons. They learn to take the leadership for parts of a project or the whole. They are able to familiarize themselves with a topic and to select suitable methods to solve questions and problems. They are able to acquire the necessary information about a topic on one's own and to put the new information in the context of their knowledge.

The graduates are further qualified to develop concept designs for difficult projects in structural engineering, foundation engineering, bridge design and hydraulic engineering and to plan such constructions under consideration of the available information and restrictions. They can:

- successfully cooperate with expert und inexpert partners from the public administration, the economy and science,
- autonomously define, plan and conduct scientific tasks and to theoretically or experimentally investigate constructions, ground, materials, infrastructure as well as management duties,
- responsibly evaluate and consider the interests of building partners, people concerned and the society as a whole.

Program structure

The master program consists of modules which 6 credit points according to ECTS (CP) except for the master thesis. It is divided into a "Core Qualification", into the four alternative specializations "Harbor Construction and Coast Protection", "Underground Engineering", "Structures" and "Water and Traffic", as well as the master thesis. The core qualification covers 24 CP, each specialization covers 66 CP and the master thesis covers 30 CP. The program covers 120 CP in 2 years with 4 terms in total.

The core qualification contains a module "Finite Elements Methods" as well as a module "Sustainability and Risk Management" in the 1st term. In addition an open module during the 1st, 2nd or 3rd term from the field "Business and Management" as well as a module from the "Non-technical Courses for Master" are incorporated. The lectures of these open modules are selected from catalogs that are independend from the specific master program.

Each specialization covers 42 CP in the compulsory modules, that are indispensable for the specialization, and 24 CP in the mandatory electives. They contain also an open module and a project work with 6 CP in each case. The compulsory modules excepting the project work are located in the 1st and 2nd term.

The 4th term covers the master thesis. In addition lectures of the open module of the specialization can still be attended in the 4th term. The students must select a specialization and they have the choice to elect different options in the field of "Business and Management", in the field of the "Non-technical Courses for Master" and in the mandatory electives of the specialization.

A term abroad is possible. In particular the 3rd semester is used by the students to go abroad, because in the 3rd term there are no compulsory modules, but only mandatory electives.

Core Qualification

Module M0523: Busin	ess & Management
Module Responsible	Prof. Matthias Meyer
Admission Requirements	None
Recommended Previous	None
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge Skills	 Students are able to find their way around selected special areas of management within the scope of business management. Students are able to explain basic theories, categories, and models in selected special areas of business management. Students are able to interrelate technical and management knowledge. Students are able to apply basic methods in selected areas of business management. Students are able to explain and give reasons for decision proposals on practical issues in areas of business management.
Personal Competence Social Competence Autonomy	 Students are able to communicate in small interdisciplinary groups and to jointly develop solutions for complex problems Students are capable of acquiring necessary knowledge independently by means of research and preparation of material.
Workload in Hours	Depends on choice of courses
Credit points	6

Courses

Information regarding lectures and courses can be found in the corresponding module handbook published separately.

Module Responsible	Dagmar Richter
Admission Requirements	None
Recommended Previous Knowledge	None
Educational Objectives	After taking part successfully, students have reached the following learning results
rofessional Competence	
Knowledge	The Nontechnical Academic Programms (NTA)
	imparts skills that, in view of the TUHH's training profile, professional engineering studies require but are not able to cover full Self-reliance, self-management, collaboration and professional and personnel management competences. The departmer implements these training objectives in its teaching architecture , in its teaching and learning arrangements , in teaching areas and by means of teaching offerings in which students can qualify by opting for specific competences and a competence level at the Bachelor's or Master's level. The teaching offerings are pooled in two different catalogues for nontechnic complementary courses.
	The Learning Architecture
	consists of a cross-disciplinarily study offering. The centrally designed teaching offering ensures that courses in the nontechnica academic programms follow the specific profiling of TUHH degree courses.
	The learning architecture demands and trains independent educational planning as regards the individual development o competences. It also provides orientation knowledge in the form of "profiles".
	The subjects that can be studied in parallel throughout the student's entire study program - if need be, it can be studied in one t two semesters. In view of the adaptation problems that individuals commonly face in their first semesters after making th transition from school to university and in order to encourage individually planned semesters abroad, there is no obligation t study these subjects in one or two specific semesters during the course of studies.
	Teaching and Learning Arrangements
	provide for students, separated into B.Sc. and M.Sc., to learn with and from each other across semesters. The challenge of dealin with interdisciplinarity and a variety of stages of learning in courses are part of the learning architecture and are deliberatel encouraged in specific courses.
	Fields of Teaching
	are based on research findings from the academic disciplines cultural studies, social studies, arts, historical studie communication studies, migration studies and sustainability research, and from engineering didactics. In addition, from the winte semester 2014/15 students on all Bachelor's courses will have the opportunity to learn about business management and start-up in a goal-oriented way.
	The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging goa oriented communication skills, e.g. the skills required by outgoing engineers in international and intercultural situations.
	The Competence Level
	of the courses offered in this area is different as regards the basic training objective in the Bachelor's and Master's fields. Thes differences are reflected in the practical examples used, in content topics that refer to different professional application context and in the higher scientific and theoretical level of abstraction in the B.Sc.
	This is also reflected in the different quality of soft skills, which relate to the different team positions and different group leadersh functions of Bachelor's and Master's graduates in their future working life.
	Specialized Competence (Knowledge)
	Students can
	 explain specialized areas in context of the relevant non-technical disciplines, outline basic theories, categories, terminology, models, concepts or artistic techniques in the disciplines represented in the learning area, different specialist disciplines relate to their own discipline and differentiate it as well as make connections, sketch the basic outlines of how scientific disciplines, paradigms, models, instruments, methods and forms of representation in the specialized sciences are subject to individual and socio-cultural interpretation and historicity, Can communicate in a foreign language in a manner appropriate to the subject.
Skills	Professional Competence (Skills)
	In selected sub-areas students can
	 apply basic and specific methods of the said scientific disciplines, aquestion a specific technical phenomena, models, theories from the viewpoint of another, aforementioned special discipline, to handle simple and advanced questions in aforementioned scientific disciplines in a sucsessful manner, justify their decisions on forms of organization and application in practical questions in contexts that go beyond to technical relationship to the subject.

Module Manual M.Sc. "Civil Engineering"

Personal Competence	
Social Competence	Personal Competences (Social Skills)
	 Students will be able to learn to collaborate in different manner, to present and analyze problems in the abovementioned fields in a partner or group situation in a manner appropriate to the addressees, to express themselves competently, in a culturally appropriate and gender-sensitive manner in the language of the country (as far as this study-focus would be chosen), to explain nontechnical items to auditorium with technical background knowledge.
Autonomy	Personal Competences (Self-reliance)
	Students are able in selected areas
	 to reflect on their own profession and professionalism in the context of real-life fields of application
	to organize themselves and their own learning processes
	 to reflect and decide questions in front of a broad education background to communicate a nontechnical item in a competent way in writen form or verbaly.
	 to organize themselves as an entrepreneurial subject country (as far as this study-focus would be chosen)
Workload in Hours	Depends on choice of courses
Credit points	6

Courses

Information regarding lectures and courses can be found in the corresponding module handbook published separately.

Module M0808: Finite	e Elements Methods			
Courses				
Title Finite Element Methods (L0291)		Typ Lecture	Hrs/wk	СР 3
Finite Element Methods (L0804)		Recitation Section (large)	2	3
Module Responsible	Prof. Otto von Estorff			
Admission Requirements	None			
Recommended Previous	Mechanics I (Statics, Mechanics of Materials) and Mechanics	s II (Hydrostatics, Kinematics, Dyna	amics)	
Knowledge	Mathematics I, II, III (in particular differential equations)			
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence	······································			
Knowledge	The students possess an in-depth knowledge regarding to overview of the theoretical and methodical basis of the methodical bas	the derivation of the finite eleme thod.	ent method and	are able to give an
Skills	The students are capable to handle engineering problems system matrices, and solving the resulting system of equat	by formulating suitable finite eler ions.	nents, assemblir	ng the corresponding
Personal Competence				
Social Competence	Students can work in small groups on specific problems to a	arrive at joint solutions.		
,				
Autonomy	The students are able to independently solve challengin Problems can be identified and the results are critically scru	g computational problems and c itinized.	levelop own fini	te element routines.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	Compulsory Bonus Form Description	on		
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Core Qualification: Compulsory			
Following Curricula	Energy Systems: Core Qualification: Elective Compulsory			
	Aircraft Systems Engineering: Specialisation Aircraft System	ns: Elective Compulsory		
	Aircraft Systems Engineering: Specialisation Aircraft System	ns: Elective Compulsory		
	Aircraft Systems Engineering: Specialisation Air Transportat	ion Systems: Elective Compulsory		
	Aircraft Systems Engineering: Specialisation Air Transportat	ion Systems: Elective Compulsory		
	International Management and Engineering: Specialisation	II. Mechatronics: Elective Compuls	ory	
	International Management and Engineering: Specialisation	II. Product Development and Produ	uction: Elective C	ompulsory
	International Management and Engineering: Specialisation	II. Product Development and Produ	iction: Elective C	ompulsory
	Mechatronics: Core Qualification: Compulsory			
	Biomedical Engineering: Specialisation Implants and Endop	rostheses: Compulsory		
	Biomedical Engineering: Specialisation Management and Bu	usiness Administration: Elective Co	mpulsory	
	Biomedical Engineering: Specialisation Medical Technology	and Control Theory: Elective Com	oulsory	
	Biomedical Engineering: Specialisation Artificial Organs and	Regenerative Medicine: Elective O	Compulsory	
	Product Development, Materials and Production: Core Quali	fication: Compulsory		
	Technomathematics: Specialisation III. Engineering Science	: Elective Compulsory		
	Theoretical Mechanical Engineering: Core Qualification: Core			
	meoretical Mechanical Engineering: Core Qualification: Cor	iipuis0l y		

Course L0291: Finite Element Methods		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Otto von Estorff	
Language	EN	
Cycle	WiSe	
Content	- General overview on modern engineering	
	- Displacement method	
	- Hybrid formulation	
	- Isoparametric elements	
	- Numerical integration	
	- Solving systems of equations (statics, dynamics)	
	- Eigenvalue problems	
	- Non-linear systems	
	- Applications	
	- Programming of elements (Matlab, hands-on sessions)	
	- Applications	
Literature	Bathe, KJ. (2000): Finite-Elemente-Methoden. Springer Verlag, Berlin	

Course L0804: Finite Element Methods		
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Otto von Estorff	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0962: Susta	inability and Risk Managem	ent		
Courses				
Title		Тур	Hrs/wk	СР
Safety, Reliability and Risk Assessm	nent (L1145)	Seminar	2	3
Environment and Sustainability (L0	319)	Lecture	2	3
Module Responsible	Prof. Kerstin Kuchta			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Protessional Competence	Chudanta and able to dependencia inclusion		of cofety, and side of	
Knowledge	Students are able to describe single teo	chniques and to give an overview for the field	of safety and risk as	sessment as well as
	environmentar and sustainable engineen			
	 basics in safety and reliability of te 	echnical facilities		
	 safety and reliability analysis meth 	nods		
	risk assessment			
	Production and usage of bio-char			
	energy production and supply sustainable product design			
	 sustainable product design 			
Skille	Students are able apply interdisciplinar	w system-oriented methods for risk assessme	ant and sustainability	reporting They can
JKIIIS	evaluate the effort and costs for process	es and select economically feasible treatment c	oncepts	reporting. They can
			onceptor	
Personal Competence				
Social Competence				
Autonomy	Students can gain knowledge of the sul	bject area from given sources and transform it	to new questions. Fu	irthermore, they can
	define targets for new application or reso	earch-oriented duties in for risk management a	nd sustainability conc	epts accordance with
	the potential social, economic and cultur	al impact.		
Workload in Hours	Independent Study Time 124, Study Time	e in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Elaboration and presentation (45 minute	s in groups)		
scale				
Assignment for the	Civil Engineering: Core Qualification: Con	npulsory		
Following Curricula	Bioprocess Engineering: Specialisation	C - Bioeconomic Process Engineering, Focu	s Management and	Controlling: Elective
	Compulsory			
	International Management and Engineeri	ng: Specialisation II. Civil Engineering: Elective	Compulsory	
	Product Development, Materials and Prod	duction: Specialisation Product Development: El	ective Compulsory	
	Product Development, Materials and Prod	duction: Specialisation Production: Elective Com	pulsory	
	Product Development, Materials and Prod	auction: Specialisation Materials: Elective Comp	uisory	
	water and Environmental Engineering: C	ore Qualification: Compulsory		

Course L1145: Safety, Reliability and Risk Assessment		
Тур	Seminar	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Dr. Marco Ritzkowski	
Language	DE	
Cycle	WiSe	
Content	An introduction in safety and risk assessment is given and some typical problems of structural and environmental engineering are treated: • basics in safety and reliability of technical facilities • safety and reliability analysis methods • risk assessment • practical examples and excursions • discussions and presentations	
Literature	- Vorlesungsunterlagen - Schneider, J., Schlatter, H.P.: Sicherheit und Zuverlässigkeit im Bauwesen. www.risksafety.ch/files/ sicherheit _und_zuverlaessigkeit.pdf	

Course L0319: Environment and Sustainability		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Kerstin Kuchta	
Language	EN	
Cycle	WiSe	
Content	This course presents actual methodologies and examples of environmental relevant, sustainable technologies, concepts and	
	strategies in the field of energy supply, product design, water supply, waste water treatment or mobility. The following list show	
	examples.	
	Production and Usage of Bio-char	
	Engergy production with algae	
	Environmental product design	
	Clean Development mechanism (CDM)	
	Democracy and Energy	
	New Concepts for a sustainable Energy Supply	
	Recycling of Wind Turbines	
	Alternative Mobility	
	Disposal of Nuclear Wastes	
	Waste2Energy	
	Offshore Wind energy	
Literature	Wird in der Veranstaltung bekannt gegeben.	

Specialization Coastal Engineering

Module M0699: Geotechnics III Courses Title Тур Hrs/wk СР Numerical Methods in Geotechnics (L0375) Lecture 3 3 2 2 Advanced Foundation Engineering (L0497) Lecture Advanced Foundation Engineering (L0498) Recitation Section (large) 1 1 Module Responsible Prof. Jürgen Grabe Admission Requirements None **Recommended Previous** Knowledge Educational Objectives After taking part successfully, students have reached the following learning results **Professional Competence** Knowledge Skills Personal Competence Social Competence Autonomy Workload in Hours Independent Study Time 96, Study Time in Lecture 84 **Credit points** 6 Compulsory Bonus Form Description **Course achievement** Yes None Subject theoretical and practical work Examination Written exam Examination duration and 120 min scale Assignment for the Civil Engineering: Specialisation Structural Engineering: Compulsory **Following Curricula** Civil Engineering: Specialisation Geotechnical Engineering: Compulsory Civil Engineering: Specialisation Coastal Engineering: Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory

Course L0375: Numerical Methods in Geotechnics	
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Dr. Hans Mathäus Stanford
Language	DE
Cycle	WiSe
Content	Topics:
	 numerical simulations numerical algorithms finite element method application of finite element method in geomechanics constitutive models for soils contact models for soil structure interaction selected applications
Literature	 Wriggers P. (2001): Nichtlineare Finite-Elemente-Methoden, Springer Verlag, Berlin Bathe Klaus-Jürgen (2002): Finite-Elemente-Methoden. Springer Verlag, Berlin

Course L0497: Advanced Foundation Engineering	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	 Vertical drains Piles Ground improvement (Deep Compaction, Soil mixing) Vibration driving Jet grouting Slurry wall Deep excavation
Literature	 EAK (2002): Empfehlungen für Küstenschutzbauwerke EAU (2004): Empfehlungen des Arbeitsausschusses Uferbauwerke EAB (1988): Empfehlungen des Arbeitskreises Baugruben Grundbau-Taschenbuch, Teil 1-3, (1997), Ernst & Sohn Verlag

Course L0498: Advanced Foundation Engineering	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0858: Coast	al Hydraulic Engineering I			
Courses				
Title		Тур	Hrs/wk	СР
Basics of Coastal Engineering (L08	(7)	Lecture	3	4
Basics of Coastal Engineering (L14	3)	Project-/problem-based Learning	1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Basics of hydraulic engineering, hydrology and hydror	nechanics		
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students are able to define and explain the basic	concepts of coastal engineering and port e	ngineering. T	hey are able to apply
	the concepts to selected practical problems of coasta	al engineering. Students can define and de	termine the t	basics for design and
	dimensioning of coastal engineering constructions.			
Skills	The students are capable to apply basic design approaches to selected and pre-defined design tasks in coastal engineering.			
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge in applied problems such as the design of coastal protection structure:			
	Additionaly, they will be able to work in team with eng	ineers of other disciplines, for instance des	signing of coa	stal breakwaters.
Autonomy	The students will be able to independently extend the	ir knowledge and applyit to new problems.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	6		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 2 hours. The ex	amination includes tasks with respect to	the general ι	understanding of the
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Structural Engineerin	g: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Enginee	ring: Compulsory		
	Civil Engineering: Specialisation Coastal Engineering:	Compulsory		
	International Management and Engineering: Specialis	ation II. Civil Engineering: Elective Compuls	ory	

Image: Project of the series of the serie
Hrs/wk 3 Image: Properties of the start of
4 Workload in Hours independent Study Time 78, Study Time in Lecture 42 Lecture Por. Peter Fröhle Languag DE Vorkload in Hours Wise Content • Basics of planning and design • Water levels • Water levels • Ourrents • Use • Vaves • Ice • Planning and Design in Coastal Engineering • Functional and constructional design • Functional and constructional design • Determination of design parameters • Design-approaches • Filter • Rubble mound constructions • Rubble mound constructions
Workload in Houe Independent Study Time 78, Study Time in Lecture 42 Lecture Prof. Peter Fröhle Language DE Content • Basics of planning and design • Water levels • Water levels • Ourrents • Waves • Ice • Planning and Design in Coastal Engineering • Functional and constructional design • Functional and constructional design • Determination of design parameters • Design-approaches • Filter • Rubble mound constructions
Lecture Prof. Peter Fröhle Languag DE Cycle WiSe Content • Basics of planning and design • Water levels • Water levels • Currents • Waves • Ice • Planning and Design in Coastal Engineering • Functional and constructional design • Determination of design parameters • Design-approaches • Filter • Rubble mound constructions • Rubble mound constructions
Language DE Content Vise Content • Basics of planning and design • Water levels • Vater levels • Waves • Currents • Ice • Planning and Design in Coastal Engineering • Determination of design parameters • Determination of design parameters • Design-approaches • Filter • Rubble mound constructions • Rubble mound constructions
Content · Basics of planning and design · Water levels · Water levels · Currents · Waves · Ice · Planning and Design in Coastal Engineering · Functional and constructional design · Determination of design parameters · Design-approaches · Filter · Rubble mound constructions · Rubble mound constructions
Content Basics of planning and design Water levels Currents Waves Ice Planning and Design in Coastal Engineering Functional and constructional design Determination of design parameters Design-approaches Filter Rubble mound constructions
 Basics of planning and design Water levels Currents Waves Ice Planning and Design in Coastal Engineering Functional and constructional design Determination of design parameters Design-approaches Filter Rubble mound constructions
 Value levels Currents Waves Ice Planning and Design in Coastal Engineering Functional and constructional design Determination of design parameters Design-approaches Filter Rubble mound constructions
 Varies Waves Ice Planning and Design in Coastal Engineering Functional and constructional design Determination of design parameters Design-approaches Filter Rubble mound constructions
 Ice Planning and Design in Coastal Engineering Functional and constructional design Determination of design parameters Design-approaches Filter Rubble mound constructions
 Planning and Design in Coastal Engineering Functional and constructional design Determination of design parameters Design-approaches Filter Rubble mound constructions
 Functional and constructional design Determination of design parameters Design-approaches Filter Rubble mound constructions
 Determination of design parameters Design-approaches Filter Rubble mound constructions
 Design-approaches Filter Rubble mound constructions
FilterRubble mound constructions
 Rubble mound constructions
 Piles
 Vertical constructions
Literature Coastal Engineering Manual, CEM
Vorlesungsumdruck

Course L1413: Basics of Coastal Engineering	
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0964: Underground Constructions				
Courses				
Title		Тур	Hrs/wk	СР
Applied Tunnel Constructions (L240)7)	Lecture	2	3
Introduction to tunnel construction	(L0707)	Lecture	1	2
Introduction to tunnel construction	(L1811)	Recitation Section (large)	1	1
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous	Modules from Bachelor studies Civil and environr	nental engineering:		
Knowledge	Geotechnics LII			
	Steel Structures LII			
Educational Objectives	After taking part successfully, students have read	ched the following learning results		
Professional Competence				
Knowledge	Knowledge of different tunnel construction types	as well as special methods and techniq	ues of subsoil const	ruction. The students
	get deeper knowledge of steel and ground engin	eering as well as constructions knowledge	e concerning quay w	alls. Futhermore, the
	students get all the neccessary knowledge to c	esign singular construction elements for	sheet pile walls ar	nd they know how to
	choose the right construction elements depending	g on the influencing conditions.		
Skills	Basic knowledge of tunnel design as well as practical skills in structural tunnel analysis. Furthermore, the students are able to			
	dimension sheet pile wall construction regarding	ng all constrution elements, to choose	the suitable constru	uction elements with
	respect to the influencing conditions, to design	all kinds of sheet pile walls (wave sheet	oile walls and combi	ined sheet pile walls)
	and to dimension all construction elements and o	connections.		
Personal Competence				
Social Competence	Capacity for teamwork concerning project manage	gement and design of tunnels.		
Autonomy	Promotion of independent and creative work flow	in the framework of a design exercise.		
Workload in Hours	Independent Study Time 124, Study Time in Lect	ure 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 minutes			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engin	eering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical En	gineering: Compulsory		
	Civil Engineering: Specialisation Coastal Enginee	ring: Compulsory		
	Civil Engineering: Specialisation Water and Traffi	c: Elective Compulsory		
	International Management and Engineering: Spec	cialisation II. Civil Engineering: Elective Co	ompulsory	

Course L2407: Applied Tunnel Constructions	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Jürgen Grabe, Tim Babendererde
Language	DE
Cycle	WiSe
Content	
Literature	

Course L0707: Introduction	to tunnel construction
Тур	Lecture
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Dr. Marius Milatz
Language	DE
Cycle	WiSe
Content	 Definitions Historical development in tunneling Geology for tunneling Hard rock tunneling (construction composite and machines) Tunnelung in temporarly stable soil with conventional construction methods Tunneling in soft soils (form of supports, shield types, compressed air application) Pipe jacking Tunnel Lining, tunnel supporting structures Calculation approaches for supporting structures in shield-driven tunnels Surveying for tunneling Safety requirements Construction Contract Literature and sources
Literature	Vorlesung/Übung s. www.tu-harburg.de/gbt

Course L1811: Introduction to tunnel construction	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Marius Milatz
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0511: Electr	icity Generation from Wind and H	lydro Power		
Courses				
Title		Тур	Hrs/wk	СР
Sustainability Management (L0007)	Lecture	2	1
Hydro Power Use (L0013)		Lecture	1	1
Wind Turbine Plants (L0011)		Lecture	2	3
Wind Energy Use - Focus Offshore	L0012)	Lecture	1	1
Module Responsible	Dr. Isabel Höfer			
Admission Requirements	None			
Recommended Previous	Module: Technical Thermodynamics I,			
Knowledge	Module: Technical Thermodynamics II,			
	Module: Fundamentals of Fluid Mechanics			
Educational Objectives	After taking part successfully, students have read	thed the following learning results		
Professional Competence				
Knowledge	By ending this module students can explain in	detail knowledge of wind turbines wit	th a particular focus of	f wind energy use in
	offshore conditions and can critical comment the	ese aspects in consideration of current	developments. Furthe	rmore, they are able
	to describe fundamentally the use of water powe	er to generate electricity. The students	reproduce and explain	the basic procedure
	in the implementation of renewable energy proje	cts in countries outside Europe.	-p	
	Through active discussions of various topics wi	thin the seminar of the module, stuc	ents improve their un	derstanding and the
	application of the theoretical background and are	e thus able to transfer what they have	earned in practice.	
Skills	Students are able to apply the acquired theore	etical foundations on exemplary water	r or wind power syster	ns and evaluate and
	assess technically the resulting relationships in	the context of dimensioning and open	ation of these energy s	systems. They can in
	compare critically the special procedure for the i	mplementation of renewable energy p	rojects in countries out	side Europe with the
	in principle applied approach in Europe and can a	apply this procedure on exemplary the	oretical projects.	·
Personal Competence				
Social Competence	Students can discuss scientific tasks subjet-spec	ificly and multidisciplinary within a ser	ninar.	
Autonomy	Students can independently exploit sources in t	the context of the emphasis of the le	cture material to clear	the contents of the
	lecture and to acquire the particular knowledge a	bout the subject area.		
Workload in Hours	Independent Study Time 06, Study Time in Lectu	ro 94		
Credit points	6	10 04		
Course achievement	None			
Examination	Written exam			
Examination	2.5 hours written ever 4. Prencentation in sustai	nability management		
Examination duration and	2.5 hours whitten exam + Prensentation in sustai	hability management		
Assignment for the	Civil Engineering: Englishing Structural Engine	aring Flastive Compulsory		
Eollowing Curricula	Civil Engineering: Specialisation Structural Engine	gineering: Elective Compulsory		
Following curricula	Civil Engineering: Specialisation Geotechnical Engineering	ring: Elective Compulsory		
	Energy and Environmental Engineering: Specialis	ation Energy Engineering: Elective Com	mulson	
	International Management and Engineering: Specials	cialisation II. Renewable Energy: Elective Col	ve Compulsory	
	International Management and Engineering: Spec	cialisation II. Energy and Environmenta	I Engineering: Elective	Compulsory
	Product Development Materials and Production:	Specialisation Product Development: F	lective Compulsory	compulsory
	Product Development, Materials and Production:	Specialisation Production: Elective Cor	npulsory	
	Product Development, Materials and Production:	Specialisation Materials: Elective Com	oulsorv	
	Renewable Energies: Core Qualification: Compuls	sorv		
	Theoretical Mechanical Engineering: Technical Co	omplementary Course: Elective Compu	lsory	
	Theoretical Mechanical Engineering: Specialisatic	on Energy Systems: Elective Compulso	ry	
	Process Engineering: Specialisation Environment	al Process Engineering: Elective Comp	ulsory	
	Water and Environmental Engineering: Specialisa	tion Environment: Compulsory		
	Water and Environmental Engineering: Specialisa	ation Cities: Elective Compulsory		

Course L0007: Sustainability	Management
Тур	Lecture
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dr. Anne Rödl
Language	DE
Cycle	WiSe
Content	The lecture sustainability management provide an insight into the various aspects and dimensions of sustainability. This content of the course is based on the foundations of environmental assessment; therefore the previous attendance of the lecture environmental assessment is recommended. Various valuation approaches for assessing environmental, economic and social aspects are presented. Their application and use for a sustainability management's discussion is explained by means of short technology examples and is later comprehensively presented through case examples. Introduction to the topic of sustainability Dimensions of sustainability: ecology economics social Transition from the environmental assessment for sustainability management Case Studies Excursion
	Objective: The aim of the course is to learn methods for the assessment of sustainability aspects and apply for sustainability management.
Literature	Engelfried, J. (2011) Nachhaltiges Umweltmanagement. München: Oldenbourg Verlag. 2. Auflage
	Corsten H., Roth S. (Hrsg.) (2011) Nachhaltigkeit - Unternehmerisches Handeln in globaler Verantwortung. Wiesbaden: Gabler Verlag.

Course L0013: Hydro Power	Use
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Stefan Achleitner, Hugo Götsch
Language	DE
Cycle	SoSe
Content	 Introduction, importance of water power in the national and global context Physical basics: Bernoulli's equation, usable height of fall, hydrological measures, loss mechanisms, efficiencies Classification of Hydropower: Flow and Storage hydropower, low and high pressure systems Construction of hydroelectric power plants: description of the individual components and their technical system interaction Structural engineering components; representation of dams, weirs, dams, power houses, computer systems, etc. Energy Technical Components: Illustration of the different types of hydraulic machinery, generators and grid connection Hydropower and the Environment Examples from practice
Literature	 Schröder, W.; Euler, G.; Schneider, K.: Grundlagen des Wasserbaus; Werner, Düsseldorf, 1999, 4. Auflage Quaschning, V.: Regenerative Energiesysteme: Technologie - Berechnung - Simulation; Carl Hanser, München, 2011, 7. Auflage Giesecke, J.; Heimerl, S.; Mosony, E.: Wasserkraftanlagen - Planung, Bau und Betrieb; Springer, Berlin, Heidelberg, 2009, 5. Auflage von König, F.; Jehle, C.: Bau von Wasserkraftanlagen - Praxisbezogene Planungsunterlagen; C. F. Müller, Heidelberg, 2005, 4. Auflage Strobl, T.; Zunic, F.: Wasserbau: Aktuelle Grundlagen - Neue Entwicklungen; Springer, Berlin, Heidelberg, 2006

Course L0011: Wind Turbine Plants	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Rudolf Zellermann, Dr. Jochen Oexmann
Language	DE
Cycle	SoSe
Content	 Historical development Wind: origins, geographic and temporal distribution, locations Power coefficient, rotor thrust Aerodynamics of the rotor Operating performance Power limitation, partial load, pitch and stall control Plant selection, yield prediction, economy Excursion
Literature	Gasch, R., Windkraftanlagen, 4. Auflage, Teubner-Verlag, 2005

Course L0012: Wind Energy	Use - Focus Offshore
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Martin Skiba
Language	DE
Cycle	SoSe
Content	 Introduction, importance of offshore wind power generation, Specific requirements for offshore engineering Physical fundamentals for utilization of wind energy Design and operation of offshore wind turbines, presentation of different concepts of offshore wind turbines, representation of the individual system components and their system-technical relationships Foundation engineering, offshore site investigation, presentation of different concepts of offshore foundation structures, planning and fabrication of foundation structures Electrical infrastructure of an offshore wind farm, Inner Park cabling, offshore substation, grid connection Installation of offshore wind farms, installation techniques and auxiliary devices, construction logistics Development and planning of offshore wind farms Operation and optimization of offshore wind farms Day excursion
Literature	 Gasch, R.; Twele, J.: Windkraftanlagen - Grundlagen, Entwurf, Planung und Betrieb; Vieweg + Teubner, Stuttgart, 2007, 7. Auflage Molly, J. P.: Windenergie - Theorie, Anwendung, Messung; C. F. Müller, Heidel-berg, 1997, 3. Auflage Hau, E.: Windkraftanalagen; Springer, Berlin, Heidelberg, 2008, 4.Auflage Heier, S.: Windkraftanlagen - Systemauslegung, Integration und Regelung; Vieweg + Teubner, Stuttgart, 2009, 5. Auflage Jarass, L.; Obermair, G.M.; Voigt, W.: Windenergie: Zuverlässige Integration in die Energieversorgung; Springer, Berlin, Heidelberg, 2009, 2. Auflage

Module M1351: Const	ruction Processes			
Courses				
Title		Тур	Hrs/wk	СР
Digital Building (L1908)		Lecture	2	2
Lean Construction (L1910)		Lecture	2	2
System Dynamics (L1909)		Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal I	Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotech	nical Engineering: Elective Compulsory		
-	Civil Engineering: Specialisation Structura	al Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water ar	nd Traffic: Elective Compulsory		

Course L1908: Digital Building	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Katja Maaser
Language	DE
Cycle	SoSe
Content	
Literature	

Course L1910: Lean Construction	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Theo Herzog
Language	DE
Cycle	SoSe
Content	
Literature	

Course L1909: System Dynamics	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Markus Salge
Language	DE
Cycle	SoSe
Content	
Literature	

Module M0593: Building Materials and Building Preservation

Courses				
Title	Тур	Hrs/	wk CF	Р
Repair of Structures (L0255)	Lecture	1	1	
Mineral Building Materials (L0253)	Lecture	2	2	
Technology of mineral Building Mat	terials (L0256) Project-/problem-based Lear	ning 1	2	
Transport Processes in Building Ma	terials and Damage Processes (L0254) Lecture	1	1	
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous	Basic knowledge about building materials, building physics and building chemistry, for	example by	y the modules	s Principles of
Knowledge	Building Materials and Building Physics and Building Materials and Building Chemistry.			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	The students are able to describe the components of mineral building materials and their fu	nction in de	etail and to us	e them for the
	manufacture of special mineral building materials. They are able to show the characteristics	of mineral	building mate	erials. They are
	able to describe the manufacture, properties and fields of application of special mortars an	d special co	ncretes and th	he correlations
	of their material parameters. They are able to show the principles of anchor technology and	design.		
Chille		havial That		
SKIIIS	The students are able to perform an optimization of granulometry of a mineral building ma	teriai. They	are able to de	esign a special
	mineral mortar and to manufacture this mortar. The students are able to manufacture pos	t installed r	repar connect	o coloct roppir
	able to recognize damages, to assess possible causes, to use the fundamentals of constru-	iction prese	ervation and to	o select repair
	and strengthening measures.			
Personal Competence				
Social Competence	The students are able to develop in small grous the mixture of a special mortar. They pres	ent their res	sults to the lea	cturer and the
	other students. In a critical discussion they defend and adjust their results. The students	are able t	o manufactur	e their special
	building material on the basis of this feedback.			
Autonomy	The students are able to responsibly use the resources of materials and lab equipment for	their proje	ct and to inve	estigate and to
	get missing components.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	Compulsory Bonus Form Description			
	Yes 20 % Subject theoretical and			
	practical work			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnical Engineering: Compulsory			
Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory			

Course L0255: Repair of Structures	
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Frank Schmidt-Döhl
Language	DE
Cycle	SoSe
Content	Maintenance of structures, repair and strengthening, subsequent waterproofing of structures
Literature	BetonMarketing Deutschland (Hrsg.): Stahlbetonoberflächen - schützen, erhalten, instandsetzen

Course L0253: Mineral Building Materials		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Frank Schmidt-Döhl	
Language	DE	
Cycle	SoSe	
Content	Components of mineral building materials and their function, binding materials, concrete and mortar, special mortars, special	
	concretes	
Literature	Taylor, H.F.W.: Cement Chemistry	
	Springenschmid, R.: Betontechnologie für die Praxis	

Course L0256: Technology of mineral Building Materials	
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Frank Schmidt-Döhl
Language	DE
Cycle	SoSe
Content	Design and production of a special mineral building material
Literature	Taylor, H.F.W.: Cement Chemistry
	Springenschmid, R.: Betontechnologie für die Praxis

Course L0254: Transport Processes in Building Materials and Damage Processes	
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Frank Schmidt-Döhl
Language	DE
Cycle	SoSe
Content	Transport Processes in Building Materials and Damage Processes
Literature	Blaich, J.: Bauschäden, Analyse und Vermeidung

Module M0723: Desig	n of Prestressed Structures	and Concrete Bridges		
Courses				
Title		Тур	Hrs/wk	СР
Design of Prestressed Structures a	nd Concreet Bridges (L0603)	Lecture	3	4
Design of Prestressed Structures and Concreet Bridges (L0604) Recitation Section (large) 2			2	
Module Responsible	Prof. Günter Rombach			
Admission Requirements	None			
Recommended Previous	Detailed knowledge on the design of cond	Detailed knowledge on the design of concrete structures.		
Knowledge	Modules: Reinforced Concrete Structures	I+II, Structural Analysis I+II, Mechanics I+II, Con	crete Structures	
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	The students know the main bridge types, their applications and the various loads. They can explain the basic design methods			
	They can explain the design of a prestres	sed bridge.		
Skills	The students are able to design reinforced or prestressed concrete bridges.			
Personal Competence				
Social Competence	The students can design in teamwork a re	eal concrete bridge.		
Autonomy	The students are able to design a prestre	ssed concrete bridge and discuss the problems a	nd results with othe	er students.
Workload in Hours	Independent Study Time 110, Study Time	e in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 minutes			
scale				
Assignment for the	Civil Engineering: Specialisation Structure	al Engineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechr	nical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal E	Engineering: Elective Compulsory		
	International Management and Engineering	ng: Specialisation II. Civil Engineering: Elective Co	ompulsory	

Course L0603: Design of Pres	stressed Structures and Concreet Bridges
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	SoSe
Content	prestressed structures
	 basis of prestressed structures, field of application differences between reinforced and prestressed concrete structures history of prestressing construction materials: concrete, tendons, ducts, anchorage systems construction: prestressing methods prestressing forces and member forces (friction, elongation) tendon layout time dependant prestressing losses design of prestressed structures design of anchorage region non-bonded prestressing prestressed flat slabs
	Concrete bridges history of bridges design of bridges loads on bridges loads on bridges member forces for slab, T-beam, hollow box, frame and arch bridges precast bridges - precast segmental bridges bearings abutments, columns construction methods damages - checking of bridges
Literature	 Vorlesungsumdruckim STUDiP Rombach, G. (2003): Spannbetonbau. Ernst & Sohn, Berlin Wicke, M. (2002): Anwendung des Spannbetons. Betonkalender 2002, Teil II, S. 113-180, Verlag Ernst & Sohn, Berlin Leonhardt, F. (1980): Vorlesungen über Massivbau. Teil 5: Spannbeton. Berlin Mehlhorn, G. (2007): Handbuch Brücken, Springer Verlag Schäfer, H.; Kaufeld, K. (1997): Massivbrücken. Betonkalender Teil II, S. 443ff, Ernst & Sohn, Berlin Menn, Ch. (1986): Stahlbetonbrücken. Springer Verlag, Wien

Course L0604: Design of Prestressed Structures and Concreet Bridges		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Günter Rombach	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Madula MOZEC, Call N	to also also and	Demonster				
Module M0756: 5011 M	iechanics and -	Dynamics				
Courses						
Title				Тур	Hrs/wk	СР
Soil Mechanics - Selected Topics (L	0374)			Lecture	2	2
Soil Dynamics (L0452)				Lecture	3	2
Experimental Researches in Geotec	chnics (L0706)			Practical Course	1	2
Module Responsible	Prof. Jürgen Grabe					
Admission Requirements	None					
Recommended Previous	modules: Mathematic	s I-III, Mechanics I-II, Geo	otechnics I			
Knowledge	courses: Soil laborato	ry course, (Applied struc	ctural dynamics)			
Educational Objectives	After taking part succ	essfully, students have r	reached the followin	g learning results		
Professional Competence						
Knowledge	After the successful c	ompletion of the module	e the students should	d be able to:		
	 to derive and t 	o apply the basic equation	on of a simple mass	oscillator		
	 to understand 	the wave propagation in	the soil under dyna	mic excitation and to	detect the relevant par	ameters,
	 to know the es 	sential laboratory and fie	eld tests to determir	e soil dynamic charac	teristics and to evaluat	e them,
	 to design mach 	nine foundations to dyna	mic load,			
	 to measure sho 	ocks to perform vibration	n forecast,			
	 to evaluate sho 	 to evaluate shocks in term to their effect on people and buildings, 				
	 to evaluate post 	to evaluate possibilities of isolation,				
	 to understand 	 to understand mechanisms that cause earthquakes and evaluate earthquake in term of their magnitude and intensity, to know methods to determine axial allo capacity, integrity, and the dynamic hedding medulus. 				
	 to know metho 	ds to determine axial pil	le capacity, integrity	and the dynamic bed	lding modulus,	
	 to know the methodal 	echanisms that lead to a ,	a deformation accun	nulation due to cyclic	loading and to estimate	e these deformations
	to distinguish t	 to distinguish the area of application of the method of elastodynamics and plastodynamics, 				
	- to distinguish the area of appreadon of the method of clastodynamics and plastodynamics,					
	 to detect the undrained shear strength as a function of a number of state variables, 					
	 to capture the visous behaviour of cohesive soils and to consider the effects of creep and rate-dependent shear strength in 					
	calculations,					
	 to consider the 	impact of the partly sat	urated of a seepage	and shear strength.		
Skills						
Personal Competence						
Social Competence						
Autonomy						
Workload in Hours	Independent Study Ti	me 96, Study Time in Le	ecture 84			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	Yes 15 %	Subject theoretical	and			
		practical work				
Examination	Written exam					
Examination duration and	150 min					
Scale	Civil Engineering: Co	veialization Structural F-	ginooring, Elective (`ompulcon/		
Assignment for the	Civil Engineering: Spe	cialisation Geotechnical	Engineering: Elective C	ulsory		
i onowing curricula	Civil Engineering: Spe	cialisation Coastal Engin	neering: Elective Cor	npulsorv		
1	Engineering. ope	Eligit				

Course L0374: Soil Mechanics - Selected Topics		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Hans Mathäus Stanford	
Language	DE	
Cycle	SoSe	
Content	selected topis:	
	- continuum mechanis	
	- constitutive modelling	
	- time and rate dependend material behavior of soils	
	- cyclic loading	
	- undrained conditions	
Literature	Kolymbas D. (2007): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. Springer Verlag	

Course L0452: Soil Dynamics	i de la constanción d
Тур	Lecture
Hrs/wk	3
СР	2
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42
Lecturer	Alexander Chmelnizkij
Language	DE
Cycle	SoSe
Content	• mass-spring-damper systems,
	• wave propagation in soils,
	• dynamic soil parameters,
	Determination of dynamic soil parameters,
	• machine foundations,
	• in-situ measurement of ground motion, ground motion prediction, evaluation of ground motion,
	• ground motion shielding,
	• introduction into earthquake engineering,
	• dynamic pile tests,
	cyclic accumulation,
	• plastodynamics
Literature	 Das B.M.: Fundamentals of Soil Dynamics, Elsevier Empfehlungen des Arbeitskreises Baugrunddynamik. Hrsg. Deutsche Gesellschaft für Geotechnik (DGGT) Haupt W.: Bodendynamik. Vieweg und Teubner Meskouris K. und Hinzen KG.: Bauwerke und Erdbeben. Vieweg Verlag Studer J.A., Koller M.G. und Laue J.: Bodendynamik, Springer Verlag

Course L0706: Experimental	Researches in Geotechnics
Тур	Practical Course
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Dr. Marius Milatz
Language	DE
Cycle	SoSe
Content	The students are supposed to:
	 become acquainted with geotechnical model tests, field tests and laboratory tests as well as corresponding measurement techniques. These compromise amongst others inclinometer measurements and geophone measurements as well as high-grade laboratory tests on the stress-strain relationship of soil specimens, e. g. triaxial tests, simple shear tests and resonant column tests. gain insight into current soil mechanical research. plan, coordinate, perform and evaluate soil mechanical tests in a team. discuss, reflect, review and present the obtained results in a group. An important learning target is the introduction to scientific work for students who plan a scientific career, and for those who will work in practice with the responsibility to order corresponding tests and evaluate the results. The practical laboratory work is based on annualy changing problems, which are however related to the experience and results of the preceding year's course group.
Literature	- Grabe, J. (2004): Bodenmechanik und Grundbau, Band 3 der Veröffentlichungsreihe des Instituts für Geotechnik und Baubetrieb, Technische Universität Hamburg-Harburg.
	- Kolymbas, D. (2007): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. 2., korrigierte und ergänzte Auflage, Springer Verlag.
	 Normen zu geotechnischen Versuchsgeräten und Versuchsverfahren: DIN 18135:2012-04: Baugrund, Untersuchung von Bodenproben - Eindimensionaler Kompressionsversuch, Deutsches Institut für Normung, e. V.
	- DIN 18137-2:2011-04: Baugrund, Untersuchung von Bodenproben - Bestimmung der Scherfestigkeit - Teil 2: Triaxialversuch, Deutsches Institut für Normung e. V.

Module M0807: Bound	dary Element N	Methods				
Courses						
Title				Тур	Hrs/wk	CP
Boundary Element Methods (L0523	3)			Lecture	2	3
Boundary Element Methods (L0524	1)			Recitation Section (large)	2	3
Module Responsible	Prof. Otto von Estorf	f				
Admission Requirements	None					
Recommended Previous	Mechanics I (Statics,	Mechanics of Ma	aterials) and Mechanics	II (Hydrostatics, Kinematics, Dy	mamics)	
Knowledge	Mathematics I, II, III (Mathematics I, II, III (in particular differential equations)				
Educational Objectives	After taking part cur	cossfully, studen	ts have reached the fell	owing loorning results		
Brofessional Competence	Alter taking part suc	cessiully, studer		owing learning results		
Knowledge	The students nosses	s an in-denth k	owledge regarding the	derivation of the boundary el	ement method and	l are able to give an
Knowicage	overview of the theo	retical and meth	odical basis of the meth	ind		are able to give an
	overview of the theo		ould busis of the meth			
CI-ill-	The shudents are					
SKIIIS	The students are of	capable to han	ale engineering proble	ems by formulating suitable	boundary elemer	its, assembling the
	corresponding system	m maurices, and	solving the resulting sys	stem of equations.		
Personal Competence						
Social Competence	Students can work in	Students can work in small groups on specific problems to arrive at joint solutions.				
Autonomy	The students are ab	le to independer	ntly solve challenging o	omputational problems and de	welon own bounda	ry element routines
Autonomy	Problems can be ide	ntified and the re	esults are critically scrut	inized		ry element routilies.
Workload in Hours	Independent Study T	ime 124, Study	Time in Lecture 56			
Credit points	6	F	Description			
Course achievement	No 20 %	Midterm	Description	I		
Examination	Written exam	. naterin				
Examination duration and	90 min					
scale						
Assignment for the	Civil Engineering: Sp	ecialisation Stru	ctural Engineering: Elect	tive Compulsory		
Following Curricula	Civil Engineering: Sp	ecialisation Geol	echnical Engineering: El	lective Compulsory		
	Civil Engineering: Sp	ecialisation Coas	stal Engineering: Elective	e Compulsory		
	Energy Systems: Cor	re Qualification: I	Elective Compulsory			
	Mechanical Engineer	ring and Manage	ment: Specialisation Pro	duct Development and Product	ion: Elective Comp	ulsory
	Mechatronics: Specia	alisation System	Design: Elective Compu	lsory		
	Product Developmen	nt, Materials and	Production: Core Qualified	cation: Elective Compulsory		
	Technomathematics	: Specialisation I	II. Engineering Science:	Elective Compulsory		
	Technomathematics	: Specialisation I	II. Engineering Science:	Elective Compulsory		
	Theoretical Mechanic	cal Engineering:	Technical Complementa	ry Course: Elective Compulsory	/	
	Theoretical Mechanic	cal Engineering:	Specialisation Simulation	n Technology: Elective Compul	sory	

Course L0523: Boundary Eler	Course L0523: Boundary Element Methods		
Тур	Lecture		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Otto von Estorff		
Language	EN		
Cycle	SoSe		
Content	- Boundary value problems		
	- Integral equations		
	- Fundamental Solutions		
	- Element formulations		
	- Numerical integration		
	- Solving systems of equations (statics, dynamics)		
	- Special BEM formulations		
	- Coupling of FEM and BEM		
	- Hands-on Sessions (programming of BE routines)		
	Applications		
	- Application		
Literature	Gaul, L.; Fiedler, Ch. (1997): Methode der Randelemente in Statik und Dynamik. Vieweg, Braunschweig, Wiesbaden		
	Bathe, KJ. (2000): Finite-Elemente-Methoden. Springer Verlag, Berlin		

Course L0524: Boundary Element Methods		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Otto von Estorff	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0827: Mode	ling in Water Management				
Courses					
Title		Тур	Hrs/wk	СР	
Groundwater Modeling using Modfl	ow (L0543)	Lecture	1	1	
Groundwater Modeling using Modfl	ow (L0544)	Recitation Section (small)	2	2	
Modeling of Water Supply and Sew	er Network (L0875)	Project-/problem-based Learning	2	3	
Module Responsible	Dr. Klaus Johannsen				
Admission Requirements	None				
Recommended Previous	Groundwater				
Knowledge	groundwater hydraulics and transport of substances				
	Pipe Systems				
 Knowledge on urban water infrastructures, in particular drinking water systemsand urban drainage systemial structures Hydraulics of drinking water supply systems and sewer systems 				je systems including	
	 Basic knowledge on water management 				
Educational Objectives	After taking part successfully, students have reached	the following learning results			
Professional Competence					
Knowledge	? The students are able to describe the modelling of groundwater flow and transport as well as urban water infrastructures. They can carry out systems analyses and can detect technical and conceptual weak points within the systems in case studies. Besides the are able to analyse interdependencies of hydraulic and toxic phenomena in soil and water.				
Skills	The students are able to construct and apply scientific groundwater models indipendently. They can work on different scenarios and can compare or assess different solutions for existing problems by application of selected software products. The students are able to use different software solutions (e.g. EPANET, EPA-SWMM).				
Personal Competence					
Social Competence	Wird nicht vermittelt.				
Autonomy	Wird nicht vermittelt.				
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70			
Credit points	6				
Course achievement	None				
Examination	Oral exam				
Examination duration and	20 min				
scale					
Assignment for the	Civil Engineering: Specialisation Structural Engineerir	g: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engine	ering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineering:	Elective Compulsory			
	Civil Engineering: Specialisation Water and Traffic: El	ective Compulsory			
	Water and Environmental Engineering: Specialisation	Water: Compulsory			
	Water and Environmental Engineering: Specialisation	Environment: Elective Compulsory			
	Water and Environmental Engineering: Specialisation	Cities: Elective Compulsory			

Course L0543: Groundwater	Modeling using Modflow
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Sonja Götz
Language	DE/EN
Cycle	SoSe
Content	Introduction and application of the groundwater model MODFLOW (PMWIN); theoretical backround of the modell, students do work
	with the model PMWIN for practical case studies.
Literature	MODFLOW-Handbuch
	Chiang, Wen Hsien: PMWIN

Course L0544: Groundwater Modeling using Modflow	
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Sonja Götz
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0875: Modeling of Water Supply and Sewer Network		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Dr. Klaus Johannsen, Weitere Mitarbeiter	
Language	DE	
Cycle	SoSe	
Content		
Literature	Mutschmann/Stimmelmayr: Taschenbuch der Wasserversorgung, 16. Auflage. Springer Vieweg - Verlag. Wiesbaden 2014.	

Module M0828: Urbar	n Environmental Management			
Courses				
Title	Тур		Hrs/wk	СР
Noise Protection (L1109)	Lecture		2	2
Urban Infrastructures (L0874)	Project-/problem-based	Learning	2	4
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
Recommended Previous	Knowledge on Urban planning			
Knowledge	Knowledge on measures for climate protection			
	General knowledge of scientific writing/working			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Fromessional Competence	Students can describe urban development corridors as well as current and future urba	n environ	mental proble	ms. They are able to
Kilowieuge	explain the causes of environmental problems (like poise)	II CIIVIIUIII	nentai proble	inis. They are able to
	Students can specify applications for various technical innovations and explain why the	ese contri	bute to the im	provement of urbai
	life. They can, for example, derive and discuss measures for effective noise abatement.			
Skills	Students are able to develop specific solutions for correcting existing or future	e environ	ment-related	problems of urba
	development. They can define a range of conceptual and technical solutions for environ	nmental p	roblems for di	fferent developmen
	paths. To solve specific urban environmental problems they can select technical inno	ovations a	nd integrate	them into the urbar
	context.			
Personal Competence				
Social Competence	The students can work together in International groups.			
Autonomy	Students are able to organize their work flow to prepare themselves for presentations	and cont	ributions to t	he discussions. The
	can acquire appropriate knowledge by making enquiries independently.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Written Report plus oral Presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory			
	Environmental Engineering: Core Qualification: Elective Compulsory			
	Joint European Master in Environmental Studies - Cities and Sustainability: Core Qualific	ation: Co	mpulsory	
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective	e Compuls	ory	
	Water and Environmental Engineering: Specialisation Environment: Elective Compulsor	У		
	water and Environmental Engineering: Specialisation Cities: Compulsory			

Course L1109: Noise Protection		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Martin Jäschke	
Language	EN	
Cycle	SoSe	
Content		
Literature	1) Müller & Möser (2013): Handbook of Engineering Acoustics (also available in German)	
	2) WHO (1999): Guidelines for Community Noise	
	3) Environmental Noise Directive 2002/49/EG	
	4) ISO 9613-2 (1996): Acoustics, Attenuation of sound during propagation outdoors, Part 2: General method of calculation	

Course L0874: Urban Infrastructures				
Тур	Project-/problem-based Learning			
Hrs/wk	2			
СР	4			
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28			
Lecturer	Dr. Dorothea Rechtenbach			
Language	EN			
Cycle	SoSe			
Content	Problem Based Learning			
	 Main topics are: Central vs. Decentral Wastewater Treatment. Compaction of Cities. Car Free Cities. Multifunctional Places in Cities. The Sustainability of Freight Transport in Cities. 			
Literature	Depends on chosen topic.			
Module M0859: Coast	al Hydraulic Engineering II			
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Courses				
Title		Тур	Hrs/wk	СР
Coastal- and Flood Protection (L080	8)	Lecture	2	3
Coastal- and Flood Protection (L14)	5)	Project-/problem-based Learning	1	1
Maintennance and Defence of Floo	Protection Structures (L1411)	Lecture	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Coastal Engineering I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the foll	owing learning results		
Professional Competence				
Knowledge	The students have the capability to define and explain in detail the important aspects of erosion protection and flood protection			
	and are able to apply the aspects to practical coastal proj	ection problems. They are able to	design and	dimension importar
	coastal protection measures from the functional and from the	e constructional point of view.		
	The state of the s	6		
SKIIIS	The students are able to select design approaches for the	functional and constructional desig	in of erosion	and flood protectio
	measures and apply these approaches to practical design tas	SK5.		
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge in	applied problems such as the fund	ctional and co	onstructive design of
	coastal and flood protection structures. Additionaly, they will	be able to work in team with engine	eers of other d	lisciplines.
Autonomy	The students will be able to independently extend their know	ledge and apply it to new problems		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 130 min. The examinat	ion includes tasks with respect to	the general ι	understanding of th
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elect	ive Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: E	ective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Compu	lsory		

Course L0808: Coastal- and	Flood Protection
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	SoSe
Content	Protection of sandy coasts
	Sediment transport
	Technical solution for the protection of sandy coasts
	Construction in direction of the coast
	Constructions perpendicular to the coast
	Other Concepst
	Calculation approaches and numerical models
	Flood Protection
	Classification of constructions / measures
	• Dikes
	• Dunes
	Foreland - constructions
	Flood-Protection Walls
	Drainage of the hinterland
Literature	Vorlesungsumdruck
	Coastal Engineering Manual CEM

Course L1415: Coastal- and Flood Protection	
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1411: Maintennance and Defence of Flood Protection Structures	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Olaf Müller
Language	DE
Cycle	SoSe
Content	 Dike protection Maintennance of flood protection measures
Literature	Vorlesungsumdruck

Module M0860: Harbo	our Engineering and Harbour Pl	anning		
Courses				
Title		Тур	Hrs/wk	СР
Harbour Engineering (L0809)		Lecture	2	2
Harbour Engineering (L1414)		Project-/problem-based Learning	g 1	2
Port Planning and Port Construction	n (L0378)	Lecture	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Basics of coastal engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	The students are able to define in details an	d to choose design approaches for the functiona	design of a po	ort and apply them t
	design tasks. They can design the fundament	al elements of a port.		
Skills	The students are able to select and apply app	ropriate approaches for the functional design of p	oorts.	
Personal Competence				
Social Competence	The students are able to deploy their gained	knowledge in applied problems such as the fur	ctional design	of ports. Additional
	they will be able to work in team with engine	ers of other disciplines.		
Autonomy	The students will be able to independently ex	tend their knowledge and apply it to new problen	ıs.	
Workload in Hours	Independent Study Time 110, Study Time in I	ecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 150 min	. The examination includes tasks with respect t	o the general	understanding of th
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Structural En	gineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical	Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engi	neering: Compulsory		
	Civil Engineering: Specialisation Water and Tr	affic: Elective Compulsory		
	International Management and Engineering: S	pecialisation II. Civil Engineering: Elective Compu	Ilsory	
	Theoretical Mechanical Engineering: Technica	I Complementary Course: Elective Compulsory		

Course L0809: Harbour Engineering	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	SoSe
Content	 Fundamentals of harbor engineering Maritime transportation and waterways engineering Ships Elements of harbors Harbor approaches and water-side harbor areas Terminal design and handling of cargo Quay-walls and piers Equipment of harbors Sluices and other special constructions Connection to inland transportation / inland waterway transportation Protection of harbors Breakwaters and Jetties Wave protection of harbors Fishery and other small harbors
Literature	Brinkmann, B.: Seehäfen, Springer 2005

Course L1414: Harbour Engineering	
Тур	Project-/problem-based Learning
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0378: Port Planning	and Port Construction
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Frank Feindt
Language	DE
Cycle	SoSe
Content	 Planning and implementation of major projects Market analysis and traffic relations Planning process and plan Port planning in urban neighborhood Development of the logistics center "Port of Hamburg" in the metropolis Quays and waterfront structure Special planning Law Harbor - securing of a flexible use of the port Dimensioning of quays Flood protection structures Port of Hamburg - Infrastructure and development Preparation of areas Scour formation in front of shore structures
Literature	Vorlesungsumdruck, s. www.tu-harburg.de/gbt

Module M0861: Mode	ling of Hydraulic Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Hydraulic Models (L0813)		Project-/problem-based Learning	1	1
Modelling of Waves (L0812)		Project-/problem-based Learning	1	1
Modelling of Flow in Rivers and Estu	aries (L0810)	Lecture	3	4
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Coastal Hydraulic Engineering I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fol	lowing learning results		
Professional Competence				
Knowledge	Students are able to define in detail the basic processes that are related to the modelling of flows in hydraulic engineering.			
	Besides, they can describe the basic aspects of numerical r	nodelling and actual numerical mod	els for the sir	nulation of flows and
	waves.			
Skills	Students are able to apply hydrodynamic-numerical models	to practical hydraulic engineering ta	sks.	
Personal Competence				
- Social Competence	The students are able to deploy their gained knowledge in s	imple applied problems. Additionaly	, they will be	able to work in team
	with others.			
Autonomy	The students will be able to independently extend their know	vledge and apply it to new problems		
Workload in Hours	ndependent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 3 hours. The examinat	ion includes tasks with respect to	the general u	understanding of the
scale	ecture contents and calculations tasks.		-	-
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elec	tive Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: E	lective Compulsory		
-	Civil Engineering: Specialisation Coastal Engineering: Electiv	e Compulsory		

Course L0813: Hydraulic Models	
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE/EN
Cycle	SoSe
Content	 Fundamentals of hydraulic models Model laws Pi theorem of Buckingham Practical examples of hydraulic models
Literature	Strobl, Zunic: Wasserbau, Kap. 11 Hydraulische Modelle, Springer

Course L0812: Modelling of Waves	
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE/EN
Cycle	SoSe
Content	 Waves, interactions with shallow water and constructions Wave theories Sea state and surges Development of waves Wave spectra Modelling of Waves / phase averaged and phase resolved models Application of a phase averaged model for wave prediction (SWAN) Application of phase resolved wave models (Mike)
Literature	Vorlesungsumdruck

Course L0810: Modelling of I	Flow in Rivers and Estuaries
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Dr. Edgar Nehlsen, Prof. Peter Fröhle
Language	DE/EN
Cycle	SoSe
Content	Basics of numerial models / application of models
	 classification of models model concept modelling 1D Working Equation Mathematical description of physical processes Equation of motions conservation of mass conservation of momentum Initial conditions and boundary conditions Numerical Methods Time step procedure Finite differences Finite volumes
Literatura	Varlagungsskript
Literature	voiresuriysskript

Module M0874: Wast	ewater Systems			
Courses				
Title		Түр	Hrs/wk	СР
Wastewater Systems - Collection, 1	reatment and Reuse (L0934)	Lecture	2	2
Wastewater Systems - Collection, 1	reatment and Reuse (L0943)	Recitation Section (large) 1	1
Advanced Wastewater Treatment (L0357)	Lecture	2	2
Advanced Wastewater Treatment (L0358)	Recitation Section (large) 1	1
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous	Knowledge of wastewater management an	d the key processes involved in wastewater t	eatment.	
Knowledge				
Educational Objectives	After taking part successfully, students have	ve reached the following learning results		
Professional Competence				
Knowledge	Students are able to outline key areas of the	he full range of treatment systems in waste v	vater management,	as well as their mutua
	dependence for sustainable water protection	on. They can describe relevant economic, env	ironmental and soci	al factors.
SKIIIS	Students are able to pre-design and expla	an the available wastewater treatment proce	esses and the scope	e of their application in
	municipal and for some industrial treatmen	it plants.		
Personal Competence				
Social Competence	Social skills are not targeted in this module	<u>.</u>		
Autonomy	Students are in a position to work on a s	subject and to organize their work flow inde	pendently. They ca	n also present on this
	subject.			
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural	Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnic	cal Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal En	gineering: Elective Compulsory		
	Civil Engineering: Specialisation Water and	Traffic: Compulsory		
	Bioprocess Engineering: Specialisation A - 0	General Bioprocess Engineering: Elective Com	ipulsory	
	Energy and Environmental Engineering: Sp	ecialisation Environmental Engineering: Elect	ive Compulsory	
	Environmental Engineering: Specialisation	Water: Elective Compulsory		
	International Management and Engineering	: Specialisation II. Energy and Environmental	Engineering: Electiv	e Compulsory
	International Management and Engineering	: Specialisation II. Process Engineering and B	iotechnology: Electiv	ve Compulsory
	Process Engineering: Specialisation Enviror	nmental Process Engineering: Elective Compu	lsory	
	Process Engineering: Specialisation Process	s Engineering: Elective Compulsory		
	Water and Environmental Engineering: Spe	cialisation Water: Compulsory		
	Water and Environmental Engineering: Spe	cialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Spe	cialisation Cities: Compulsory		

Course L0934: Wastewater S	systems - Collection, Treatment and Reuse
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	SoSe
Content	•Understanding the global situation with water and wastewater
	•Regional planning and decentralised systems
	•Overview on innovative approaches
	•In depth knowledge on advanced wastewater treatment options for different situations, for end-of-pipe and reuse
	•Mathematical Modelling of Nitrogen Removal
	•Exercises with calculations and design
Literature	Henze, Mogens:
	Wastewater Treatment: Biological and Chemical Processes, Springer 2002, 430 pages
	George Tchobanoglous, Franklin L. Burton, H. David Stensel:
	Wastewater Engineering: Treatment and Reuse, Metcalf & Eddy
	McGraw-Hill, 2004 - 1819 pages

Course L0943: Wastewater Systems - Collection, Treatment and Reuse	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0357: Advanced Wa	stewater Treatment
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Joachim Behrendt
Language	EN
Cycle	SoSe
Content	Survey on advanced wastewater treatment
	reuse of reclaimed municipal wastewater
	Precipitation
	Flocculation
	Depth filtration
	Membrane Processes
	Activated carbon adsorption
	Ozonation
	"Advanced Oxidation Processes"
	Disinfection
Literature	Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003
	Wassertechnologie, H.H. Hahn, Springer-Verlag, Berlin 1987
	Membranverfahren: Grundlagen der Modul- und Anlagenauslegung, T. Melin und R. Rautenbach, Springer-Verlag, Berlin 2007
	Trinkwasserdesinfektion: Grundlagen, Verfahren, Anlagen, Geräte, Mikrobiologie, Chlorung, Ozonung, UV-Bestrahlung,
	Membranfiltration, Qualitätssicherung, W. Roeske, Oldenbourg-Verlag, München 2006
	Organische Problemstoffe in Abwässern, H. Gulyas, GFEU, Hamburg 2003

Course L0358: Advanced Wa	stewater Treatment
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Joachim Behrendt
Language	EN
Cycle	SoSe
Content	Aggregate organic compounds (sum parameters)
	Industrial wastewater
	Processes for industrial wastewater treatment
	Precipitation
	Flocculation
	Activated carbon adsorption
	Recalcitrant organic compounds
Literature	Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003
	Wassertechnologie, H.H. Hahn, Springer-Verlag, Berlin 1987
	Membranverfahren: Grundlagen der Modul- und Anlagenauslegung, T. Melin und R. Rautenbach, Springer-Verlag, Berlin 2007
	Trinkwasserdesinfektion: Grundlagen, Verfahren, Anlagen, Geräte, Mikrobiologie, Chlorung, Ozonung, UV-Bestrahlung,
	Membranfiltration, Qualitätssicherung, W. Roeske, Oldenbourg-Verlag, München 2006
	Organische Problemstoffe in Abwässern, H. Gulyas, GFEU, Hamburg 2003

Module M0922: City F	Planning		
Courses			
Title	Түр	lrs/wk	СР
City Planning (L1066)	Project-/problem-based Learning 4		6
Module Responsible	Prof. Carsten Gertz		
Admission Requirements	None		
Recommended Previous	for "Principles of Urban Planning": none		
Knowledge			
	for "Designing Urban Streetscapes": some knowledge of transport planning, e.g. through taking the	undergradi	uate class "Transport
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	Students are able to:		
	• use technical terms of urban planning.		
	 describe the main determinants of urban development. 		
	explain and compare different possibilities of how urban development can be influenced.		
	discuss requirements for public streetscapes.		
	explain the importance of street design.		
Skills	Students are able to:		
	 read and analyze urban development concepts and designs for streetscapes 		
	appraise such concents in the context of competing requirements		
	 design, justify and reflect their own solutions for concrete examples. 		
Personal Competence			
Social Competence	Students are able to:		
	discuss intermediate results with each other.		
	provide constructive feedback to others		
	• provide constructive recuback to others.		
Autonomy	Students are able to		
, aconomy			
	 independently complete a written report including drawings following a broadly pre-defined p 	process.	
	assess the consequences of their proposed solutions.		
	 Independently acquire knowledge and apply this to new issues or problem areas. 		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Credit points	6		
credit points			
Course achievement	None		
Examination	Written elaboration		
Examination duration and	written assignment, designwork during the semester		
scale	Civil Engineering: Engineering: Elective Consultant		
Assignment for the	Civil Engineering: Specialisation Sciuctural Engineering: Elective Compulsory		
i onowing curricula	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory		
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective Compulsory	y	
	Water and Environmental Engineering: Specialisation Water: Elective Compulsory	-	
	Water and Environmental Engineering: Specialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Cities: Compulsory		

Course L1066: City Planning	
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Carsten Gertz
Language	DE
Cycle	SoSe
Content	"Principles of Urban Planning" deals with the determinants of urban development and their interactions. Topics include:
	 legal framework, instruments and methods of planning, functional requirements, stakeholders and actors basic design requirements different planning levels and historical contexts. The objective of the course is for students to acquire a basic understanding of urban development problems and approaches for solving them. They will also be able to comprehend the process of urban planning. The course also covers the various functional and aesthetic requirements for designing streetscape as the most important elements of public space. The project work deals with a real life scenario and includes drawing up a development plan, an urban design concept, a building masterplan and a street redesign.
Literature	Albers, Gerd; Wekel, Julian (2009) Stadtplanung: Eine illustrierte Einführung. Primus Verlag. Darmstadt. Frick, Dieter (2008) Theorie des Städtebaus: Zur baulich-räumlichen Organisation von Stadt. Wasmuth-Verlag. Tübingen Jonas, Carsten (2009) Die Stadt und ihr Grundriss. Wasmuth-Verlag. Tübingen Kostof, Spiro; Castillo, Greg (1998) Die Anatomie der Stadt. Geschichte städtischer Strukturen. Campus-Verlag. Frankfurt/New York.

Module M0977: Const	ruction Logistics and Project Manage	ement		
Courses				
Title		Тур	Hrs/wk	СР
Construction Logistics (L1163)		Lecture	1	2
Construction Logistics (L1164)		Recitation Section (small)	1	2
Project Development and Managen	nent (L1161)	Lecture	1	1
Project Development and Managen	nent (L1162)	Project-/problem-based Learning	1	1
Module Responsible	Prof. Heike Flämig			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	Students can			
	 give definitions of the main terms of construction 	on logistics and project development and n	nanagement	
	 name advantages and disadvantages of internal 	al or external construction logistics		
	 explain characteristics of products, demand an 	d production of construction objects and t	neir conseque	ences for construction
	specific supply chains			
	differentiate constructions logistics from other	logistics systems		
<i>CL 11</i>				
SKIIIS	Students can			
	 carry out project life cycle assessments 			
	 apply methods and instruments of construction 	logistics		
	 apply methods and instruments of project development 	lopment and management		
	 apply methods and instruments of conflict man 	agement		
	 design supply and waste removal concepts for 	a construction project		
Personal Competence				
Social Competence	Students can			
Social competence				
	 hold presentations in and for groups 			
	 apply methods of conflict solving skills in group 	work and case studies		
Autonomy	Students can			
	 solve problems by holistic, systemic and flow o 	riented thinking		
	 improve their creativity, negotiation skills, co 	nflict and crises solution skills by applyin	g methods o	f moderation in case
	studies			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	66		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Two written papers with presentations			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineerin	g: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineer	ering: Elective Compulsory		
_	Civil Engineering: Specialisation Coastal Engineering:	Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Ele	ective Compulsory		
	International Management and Engineering: Specialis	ation II. Civil Engineering: Elective Compuls	sory	
	International Management and Engineering: Specialis	ation II. Logistics: Elective Compulsory		
	Logistics, Infrastructure and Mobility: Specialisation Pr	roduction and Logistics: Elective Compulso	ry	
	Logistics, Infrastructure and Mobility: Specialisation In	frastructure and Mobility: Elective Comput	sorv	
	5 .,	,	,	

Course L1163: Construction	Logistics
Тур	Lecture
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Heike Flämig
Language	DE
Cycle	SoSe
Content	The lecture gives deeper insight how important logistics are as a competetive factor for construction projects and which issues are to be adressed. The following toppics are covered: competetive factor logistics the concept of systems, planning and coordination of logistics material, equipment and reverse logistics IT in construction logistics elements of the planning model of construction logistics and their connections flow oriented logistics systems for construction projects logistics concepts for ready to use construction projects (especially procurement and waste removel logistics)
	 best practice examples (construction logistics Potsdamer Platz, recent case study of the region) Contents of the lecture are deepened in special exercises.
Literature	 Flämig, Heike: Produktionslogistik in Stadtregionen. In: Forschungsverbund Ökologische Mobilität (Hrsg.) Forschungsbericht Bd. 15.2. Wuppertal 2000. Krauss, Siri: Die Baulogistik in der schlüsselfertigen Ausführung, Bauwerk Verlag GmbH Berlin 2005. Lipsmeier, Klaus: Abfallkennzahlen für Neubauleistungen im Hochbau : Verlag Forum für Abfallwirtschaft und Altlasten, 2004. Schmidt, Norbert: Wettbewerbsfaktor Baulogistik. Neue Wertschöpfungspotenziale in der Baustoffversorgung. In: Klaus, Peter: Edition Logistik. Band 6. Deutscher Verkehrs-Verlag. Hamburg 2003. Seemann, Y.F. (2007): Logistikkoordination als Organisationseinheit bei der Bauausführung Wissenschaftsverlag Mainz in Aachen, Aachen. (Mitteilungen aus dem Fachgebiet Baubetrieb und Bauwirtschaft (Hrsg. Kuhne, V.): Heft 20)

Course L1164: Construction Logistics	
Тур	Recitation Section (small)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Heike Flämig
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1161: Project Development and Management	
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Heike Flämig, Dr. Anton Worobei
Language	DE
Cycle	SoSe
Content	Within the lecture, the main aspects of project development and management are tought:
	 Terms and definitions of project management Advantages and disadvantages of different ways of project handling organization, information, coordination and documentation cost and fincance management in projects time- and capacity management in projects specific methods and instruments for successful team work Contents of the lecture are deepened in special exercises.
Literature	Projektmanagement-Fachmann. Band 1 und Band 2. RKW-Verlag, Eschborn, 2004.

Course L1162: Project Development and Management	
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Heike Flämig, Dr. Anton Worobei
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0998: Statio	s and bynamics of structures			
Courses				
Title		Тур	Hrs/wk	СР
Structural Dynamics (L1202)		Lecture	2	2
Structural Dynamics (L1203)		Recitation Section (large)	2	2
Fracture mechanics and fatigue in	steel structures (L0564)	Lecture	1	1
Fracture mechanics and fatigue in	steel structures (L0565)	Recitation Section (large)	1	1
Module Responsible	Prof. Uwe Starossek			
Admission Requirements	None			
Recommended Previous	Knowledge of linear structural analysis of	statically determinate and indeterminate struc	tures; Mechanics	I/II, Mathematics I/
Knowledge	Differential equations I			
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge	After successful completion of this module	, the student can explain the basic aspects of	dynamic effects o	n structures and th
	respective methods.			
Skills	After successful completion of this modul	le the students will be able to predict the re	sponse of materi	al and structures
JKIIIS	dynamics loading using the appropriate con	politational approaches and methods	sponse of materi	
	aynamics loading using the appropriate computational approaches and methods.			
Personal Competence				
Social Competence	Students can			
Social Competence				
	 participate in subject-specific and interest 	erdisciplinary discussions,		
	 defend their own work results in front 	t of others		
	 promote the scientific development of 	f colleagues		
	Furthermore, they can give and accept	pt professional constructive criticism		
Autonomv	Students are able to gain knowledge of the	subject area from given and other sources and	apply it to new pr	oblems. Furthermor
	they are able to structure the solution proce	ess for problems in the area of Structural Analysi	S.	
Workload in Hours	Independent Study Time 96, Study Time in I	Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	150 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural E	ngineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnic	al Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Eng	jineering: Elective Compulsory		
	Civil Engineering: Specialisation Water and	Traffic: Elective Compulsory		

Course L1202: Structural Dy	namics
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	SoSe
Content	 Single-degree-of-freedom systems: undamped and damped vibration, free vibration, forced vibrations due to harmonic, periodical or arbitrary loading, natural frequency, damping vibration isolation solution in the frequency-domain (Fourier transformation), solution in the time-domain multi-degree-of-freedom systems: continuous or discrete systems, modelling with finite elements, generalisation modal analysis power iteration according to v.Mises earthquake loading: seismological basics, response spectrum method wind-induced vibrations: engineering meteorology, aerodynamic, classification of excitation mechanisms
Literature	Clough, R.W., Penzien, J.: Dynamics of Structures. 2. Aufl., McGraw-Hill, New York, 1993.

Course L1203: Structural Dynamics		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Uwe Starossek	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0564: Fracture mech	nanics and fatigue in steel structures
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Jürgen Priebe
Language	DE
Cycle	SoSe
Content	 basics of fatigue stress and fatigue resistance and determination of fatigue strength,
	determination and use of S-N-curves and classification of notch effects,
	• set up of determination of fatigue strength under dynamic load using the accumulation formula by Palmgren-Miner,
	set up of determination of fatigue strength in different examples,
	 basics of construction and design regarding the problem of material fatigue,
	basics of linear elastic fracture mechanics under static and dynamic load,
	determination of lifetime of steel construction based on linear elastic fracture mechanics in different examples.
Literature	Seeßelberg, C.; Kranbahnen - Bemessung und konstruktive Gestaltung; 3. Auflage; Bauwerk-Verlag; Berlin 2009
	• Kuhlmann, Dürr, Günther; Kranbahnen und Betriebsfestigkeit; in Stahlbau Kalender 2003; Verlag Ernst & Sohn; Berlin 2003
	Deutscher Stahlbau-Verband (Hrsg.); Stahlbau Handbuch Band 1 Teil B; 3. Auflage; Stahlbau-Verlagsgesellschaft; Köln 1996
	Petersen, C.; Stahlbau; 3. überarb. und erw. Auflage; Vieweg-Verlag; Braunschweig 1993
	 DIN V ENV 1993-1-1: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 1-1: Allgemeine Bemessungsregeln, Bemessungsregeln f ür den Hochbau; 1993
	• DIN V ENV 1993-6: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 6: Kranbahnen; 2001
	• DIN-Fachbericht 126. Richtlinie zur Anwendung von DIN V ENV 1993-6; Nationales Anwendungsdokument (NAD); Berlin 2002

Course L0565: Fracture mechanics and fatigue in steel structures		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Jürgen Priebe	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0999: Steel	Construction Project				
Courses					
Title		Тур	Hrs/wk	СР	
Steel Construction Project (L1206)		Project Seminar	4	6	
Module Responsible	Prof. Marcus Rutner				
Admission Requirements	None				
Recommended Previous	Steel and Composite Structures				
Knowledge					
Educational Objectives	After taking part successfully, students have	reached the following learning results			
Professional Competence					
Knowledge	Students are able to prepare a part of the wh	ole project and explain it to the others.			
Skills	Students can produce sketches and calculations of their part of the project. They are able to adjust their work in reaction to				tion to
	changing conditions resulting from other part	ticipants of the project.			
Personal Competence					
Social Competence	Students can present their results to other m	embers of the group.			
	They have the ability to work for a broad agreement with respect to intergroup dependencies.				
	They can distribute and process tasks indepe	ndently.			
Autonomy	Students can handle their part of the project	on their own resposibility-			
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56			
Credit points	6				
Course achievement	None				
Examination	Written elaboration				
Examination duration and	approx. 15-20 pages (without appendix)				
scale					
Assignment for the	Civil Engineering: Specialisation Geotechnica	l Engineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Coastal Engi	neering: Elective Compulsory			
	Civil Engineering: Specialisation Structural Er	ngineering: Compulsory			

Course L1206: Steel Construction Project		
Тур	Project Seminar	
Hrs/wk	4	
СР	6	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	Prof. Marcus Rutner	
Language	DE	
Cycle	SoSe	
Content	Design of a big construction project (i.e skyscraper, large bridge, roof of a stadiuim) in small groups	
Literature	Wird je nach Projekt individuell angegeben.	

Module M0663: Marir	e Geotechnics			
Courses				
Title		Тур	Hrs/wk	СР
Marine Geotechnics (L0548)		Lecture	1	2
Marine Geotechnics (L0549)		Recitation Section (large)	2	2
Steel Structures in Foundation and	Hydraulic Engineering (L1146)	Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous	complete modules: Geotechnics I-III, Mathe	ematics I-III		
Knowledge				
	courses: Soil laboratory course			
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechni	ical Engineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Structural	Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Er	ngineering: Compulsory		
	Theoretical Mechanical Engineering: Speci	alisation Maritime Technology: Elective Compute	sory	
	Theoretical Mechanical Engineering: Techr	nical Complementary Course: Elective Compulse	ory	
	Water and Environmental Engineering: Spe	ecialisation Cities: Elective Compulsory		
	Water and Environmental Engineering: Spe	ecialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Spe	ecialisation Water: Elective Compulsory		

Course L0548: Marine Geote	chnics
Тур	Lecture
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	SoSe
Content	 Geotechnical investigation an description of the seabed Foundations of Offshore-Constructions cCliff erosion Sea dikes Port structures Flood protection structures
Literature	 EAK (2002): Empfehlungen für Küstenschutzbauwerke EAU (2004): Empfehlungen des Arbeitsausschusses Uferbauwerke Poulos H.G. (1988): Marine Geotechnics. Unwin Hyman, London Wagner P. (1990): Meerestechnik: Eine Einführung für Bauingenieure. Ernst & Sohn, Berlin

Course L0549: Marine Geotechnics		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Jürgen Grabe	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L1146: Steel Structures in Foundation and Hydraulic Engineering			
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Frank Feindt		
Language	DE		
Cycle	SoSe		
Content	Design of a sheet pile wall, design of a combined sheet pile wall, piles, walings, connections, fatigue		
Literature	EAU 2012, EA-Pfähle, EAB		

Module M1133: Port I	Logistics			
Courses				
Title		Тур	Hrs/wk	СР
Port Logistics (L0686)		Lecture	2	3
Port Logistics (L1473)		Recitation Section (small)	2	3
Module Responsible	Prof. Carlos Jahn			
Admission Requirements	none			
Knowledge	Tione			
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	Th			
	After completing the module, students can			
	 reflect on the development of seaports (in terms of relevant operator models) and place them in their h explain and evaluate different types of seaportechnologies, logistic functional areas); analyze common planning tasks (e.g. berth planni suitable approaches (in terms of methods and tools) identify future developments and trends regarding them in a problem-oriented manner. 	the functions of the ports and the c istorical context; rt terminals and their specific c ng, stowage planning, yard plannir) to solve these planning tasks; g the planning and control of innor	prresponding term haracteristics (o g) at seaport te vative seaport te	minals, as well as the argo, transhipment rminals and develop erminals and discuss
Skills	 After completing the module, students will be able to recognize functional areas in ports and seaport terminals; define and evaluate suitable operating systems for container terminals; perform static calculations with regard to given boundary conditions, e.g. required capacity (parking spaces, equipment requirements, quay wall length, port access) on selected terminal types; reliably estimate which boundary conditions influence common logistics indicators in the static planning of selected terminal types and to what extent. 			
Personal Competence Social Competence	After completing the module, students can • transfer the acquired knowledge to further questior • discuss and successfully organize extensive task pa • in small groups, document work results in writing in	is of port logistics; ickages in small groups; an understandable form and prese	nt them to an ap	propriate extent.
Autonomy	 After completing the module, the students are able to research and select specialist literature, including independently; submit own parts in an extensive written elaboratitime frame. 	standards, guidelines and journal on in small groups in due time and	papers, and to d	levelop the contents jointly within a fixed
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	b Compulsory Bonus Form Descrip	tion		
course achievement	No 15 % Written elaboration			
Examination	Written exam			
Examination duration and	120 minutes			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Elec	tive Compulsory		
Following Curricula	International Management and Engineering: Specialisation	II. Logistics: Elective Compulsory	507/	
	Logistics, Infrastructure and Mobility: Specialisation Produ	ction and Logistics: Elective Compul	sory	
	Renewable Energies: Specialisation Wind Energy Systems	Flective Compulsory	ui501 y	
	Naval Architecture and Ocean Engineering: Core Qualifica	tion: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Maritin	ne Technology: Elective Compulsorv		
	Theoretical Mechanical Engineering: Technical Compleme	ntary Course: Elective Compulsory		

Course L0686: Port Logistics	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Carlos Jahn
Language	DE
Cycle	SoSe
Content	Port Logistics deals with the planning, control, execution and monitoring of material flows and the associated information flows in the port system and its interfaces to numerous actors inside and outside the port area. The extraordinary role of maritime transport in international trade requires very efficient ports. These must meet numerous requirements in terms of economy, speed, safety and the environment. Against this background, the lecture Port Logistics deals with the planning, control, execution and monitoring of material flows and the associated information flows in the port system and
	its interfaces to numerous actors inside and outside the port area. The aim of the lecture Port Logistics is to convey an understanding of structures and processes in ports. The focus will be on different types of terminals, their characteristical layouts and the technical equipment used as well as the ongoing digitization and interaction of the players involved. In addition, renowned guest speakers from science and practice will be regularly invited to discuss some lecture-relevant topics
	 The following contents will be conveyed in the lectures: Instruction of structures and processes in the port Planning, control, implementation and monitoring of material and information flows in the port Fundamentals of different terminals, characteristical layouts and the technical equipment used Handling of current issues in port logistics
Literature	 Alderton, Patrick (2013). Port Management and Operations. Biebig, Peter and Althof, Wolfgang and Wagener, Norbert (2017). Seeverkehrswirtschaft: Kompendium. Brinkmann, Birgitt. Seehäfen: Planung und Entwurf. Berlin Heidelberg: Springer-Verlag, 2005. Büter, Clemens (2013). Außenhandel: Grundlagen internationaler Handelsbeziehungen. Gleissner, Harald and Femerling, J. Christian (2012). Logistik: Grundlagen, Übungen, Fallbeispiele. Jahn, Carlos; Saxe, Sebastian (Hg.). Digitalization of Seaports - Visions of the Future, Stuttgart: Fraunhofer Verlag, 2017. Kummer, Sebastian (2019). Einführung in die Verkehrswirtschaft Lun, Y.H.V. and Lai, KH. and Cheng, T.C.E. (2010). Shipping and Logistics Management. Woitschützke, Claus-Peter (2013). Verkehrsgeografie.

Course L1473: Port Logistics	
Тур	Recitation Section (small)
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Carlos Jahn
Language	DE
Cycle	SoSe
Content	The content of the exercise is the independent preparation of a scientific paper plus an accompanying presentation on a current topic of port logistics. The paper deals with current topics of port logistics. For example, the future challenges in sustainability and productivity of ports, the digital transformation of terminals and ports or the introduction of new regulations by the International Maritime Organization regarding the verified gross weight of containers. Due to the international orientation of the event, the paper is to be prepared in English.
Literature	 Alderton, Patrick (2013). Port Management and Operations. Biebig, Peter and Althof, Wolfgang and Wagener, Norbert (2017). Seeverkehrswirtschaft: Kompendium. Brinkmann, Birgitt. Seehäfen: Planung und Entwurf. (2005) Berlin Heidelberg: Springer-Verlag. Büter, Clemens (2013). Außenhandel: Grundlagen internationaler Handelsbeziehungen. Gleissner, Harald and Femerling, J. Christian (2012). Logistik: Grundlagen, Übungen, Fallbeispiele. Jahn, Carlos; Saxe, Sebastian (Hg.) (2017) Digitalization of Seaports - Visions of the Future, Stuttgart: Fraunhofer Verlag. Kummer, Sebastian (2019). Einführung in die Verkehrswirtschaft Lun, Y.H.V. and Lai, KH. and Cheng, T.C.E. (2010). Shipping and Logistics Management. Woitschützke, Claus-Peter (2013). Verkehrsgeografie.

Module M1132: Marit	ime Transport			
Courses				
Title		Тур	Hrs/wk	СР
Maritime Transport (L0063)		Lecture	2	3
Maritime Transport (L0064)		Recitation Section (small)	2	3
Module Responsible	Prof. Carlos Jahn			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge	The students are able to			
	 present the actors involved in the maritime t name common cargo types in shipping and c explain operating forms in maritime shipping weigh the advantages and disadvantages of present relevant factors for the location pla way; estimate the potential of digitisation in mariti 	ransport chain with regard to their typical lassify cargo to the corresponding categor , transport options and management in tra the various modes of hinterland transport nning of ports and seaport terminals and ime shipping.	tasks; ies; insport networks and apply them i discuss them ir	; in practice; n a problem-oriented
Skills	 The students are able to determine the mode of transport, actors and identify possible cost drivers in a transport of record, map and systematically analyse m problems and recommend solutions; perform risk assessments of human disruption analyse accidents in the field of maritime log deal with current research topics in the field apply different process modelling methods in 	functions of the actors in the maritime sup nain and recommend appropriate proposal aterial and information flows of a mariti ons to the supply chain; istics and evaluating their relevance in eve of maritime logistics in a differentiated wa a hitherto unknown field of activity and to	oply chain; s for cost reducti me logistics cha eryday life; y; o work out the re	on; iin, identify possible spective advantages.
Personal Competence				
Social Competence	The students are able to			
Autonomy	 discuss and organise extensive work packages in groups; document and present the elaborated results. The students are capable to research and select technical literature, including standards and guidelines; submit own shares in an extensive written elaboration in small groups in due time. 			
Workload in Hours	Independent Study Time 124, Study Time in Lectury	= 56		
Credit points	6			
Course achievement	Compulsory Bonus Form No 15 % Subject theoretical and practical work	Description Teilnahme an einem Planspiel und anschlie	eßende schriftlich	ne Ausarbeitung
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the	Civil Engineering: Specialisation Coastal Engineerin	g: Elective Compulsory		
Following Curricula	International Management and Engineering: Specia	lisation II. Logistics: Elective Compulsory		
	Logistics, Infrastructure and Mobility: Specialisation	Production and Logistics: Elective Compul	sory	
	Logistics, Infrastructure and Mobility: Specialisation	Infrastructure and Mobility: Elective Comp	ulsory	
	Renewable Energies: Specialisation Wind Energy Sy	stems: Elective Compulsory		
	Theoretical Mechanical Engineering: Specialisation	Maritime Technology: Elective Compulsory		
	Theoretical Mechanical Engineering: Technical Com	plementary Course: Elective Compulsory		

Course L0063: Maritime Tran	isport
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Carlos Jahn
Language	DE
Cycle	SoSe
Content	The general tasks of maritime logistics include the planning, design, implementation and control of material and information flows in the logistics chain ship - port - hinterland. This includes technology assessment, selection, dimensioning and implementation as well as the operation of technologies. The aim of the course is to provide students with knowledge of maritime transport and the actors involved in the maritime transport chain. Typical problem areas and tasks will be dealt with, taking into account the economic development. Thus, classical problems as well as current developments and trends in the field of maritime logistics are considered. In the lecture, the components of the maritime logistics chain and the actors involved will be examined and risk assessments of human disturbances on the supply chain will be developed. In addition, students learn to estimate the potential of digitisation in maritime shipping, especially with regard to the monitoring of ships. Further content of the lecture is the different modes of transport in the hinterland, which students can evaluate after completion of the course regarding their advantages and disadvantages.
Literature	 Brinkmann, Birgitt. Seehäfen: Planung und Entwurf. Berlin Heidelberg: Springer-Verlag, 2005. Schönknecht, Axel. Maritime Containerlogistik: Leistungsvergleich von Containerschiffen in intermodalen Transportketten. Berlin Heidelberg: Springer-Verlag, 2009. Stopford, Martin. Maritime Economics Routledge, 2009

Course L0064: Maritime Tran	isport
Тур	Recitation Section (small)
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Carlos Jahn
Language	DE
Cycle	SoSe
Content	The exercise lesson bases on the haptic management game MARITIME. MARITIME focuses on providing knowledge about structures and processes in a maritime transport network. Furthermore, the management game systematically provides process management methodology and also promotes personal skills of the participants.
Literature	 Stopford, Martin. Maritime Economics Routledge, 2009 Brinkmann, Birgitt. Seehäfen: Planung und Entwurf. Berlin Heidelberg: Springer-Verlag, 2005. Schönknecht, Axel. Maritime Containerlogistik: Leistungsvergleich von Containerschiffen in intermodalen Transportketten. Berlin Heidelberg: Springer-Verlag, 2009.

Module M1350: Excav	ation Law and Projects			
Courses				
Title Typ Hrs/wk CP		СР		
Subsoil and Underground Engineer	ng Law (L0395)	Lecture	2	2
Service Contract and Procurement	aw (L1906)	Lecture	2	2
Project Geotechnics (L0708)		Project-/problem-based Learning	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	ne following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and	30 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Structural Engineering:	: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elec	tive Compulsory		

Course L0395: Subsoil and Underground Engineering Law		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Günther Schalk	
Language	DE	
Cycle	WiSe	
Content	History of Civil Engineering Law (from 1700 BC to 2000 AD)	
	• Basics of foundation and excarvation law / engineering law (the participants in the case law of geotechnical law case studies)	
	Legal aspects of technical regulations in civil engineering (with case studies)	
	• The civil engineering contract (including checklists for the special civil engineering contract design and execution)	
	• The liability of the planner and entrepreneur in civil engineering (practical examples, jurisprudence and law, inter alia, to the Ordinance on Combatants, liability for defects and traffic safety obligations, construction law and insurance questions)	
	• The ground / foundation risk and the systemic risk (also in the European context)	
	The total debt in (low) building law (based on practice-oriented case constellations)	
	• The (construction) conflict, the dispute avoidance models and the construction process (practice-oriented presentation)	
Literature	Folienskript (in der Vorlesung erhältlich)	
	weitere Literatur:	
	Englert, Grauvogel und Maurer: Handbuch des Baugrund- und Tiefbaurechts. Werner-Verlag	

Course L1906: Service Contract and Procurement Law	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Günther Schalk, Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	
Literature	

Course L0708: Project Geotechnics		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Jürgen Grabe	
Language	DE	
Cycle	WiSe	
Content	The students solve independently a project-based geotechnical problem in groups. Additional lectures concerning the problem will	
	be held and material will be distributed as study basis. Every two weeks the groups present their current project status. The final	
	work will be presentated in a final presentation.	
Literature	abhängig von der Fragestellung	

Module M1716: Subs	urface Processes			
Courses				
Title		Тур	Hrs/wk	СР
Modeling of Subsurface Processes	(L2730)	Lecture	2	2
Modeling of Subsurface Processes	(L2731)	Recitation Section (small)	1	1
Modern Techniques for Subsurface	Solute Transport (L2728)	Lecture	2	2
Modern Techniques for Subsurface	Solute Transport (L2729)	Recitation Section (large)	1	1
Module Responsible	Prof. Nima Shokri			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reac	After taking part successfully, students have reached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6	6		
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engine	ering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Eng	ineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineer	ing: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic	: Elective Compulsory		
	Process Engineering: Specialisation Environmenta	I Process Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process Engineering: Elective Compulsory			
	Water and Environmental Engineering: Specialisat	tion Water: Compulsory		
	Water and Environmental Engineering: Specialisa	tion Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisa	tion Cities: Elective Compulsory		

Course L2730: Modeling of Subsurface Processes	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Sonja Götz
Language	EN
Cycle	WiSe
Content	
Literature	

Course L2731: Modeling of Subsurface Processes	
Тур	Recitation Section (small)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Sonja Götz
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L2728: Modern Techniques for Subsurface Solute Transport			
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Nima Shokri		
Language	EN		
Cycle	WiSe		
Content			
Literature			

Course L2729: Modern Techniques for Subsurface Solute Transport			
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Hannes Nevermann		
Language	EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M1437: Non c	lestructive testing of materials and pa	rts				
Courses						
Title		Тур	Hrs/wk	СР		
Non destructive testing of material	s and parts (L2215)	Lecture	2	2		
Non destructive testing of material	s and parts (L2217)	Project-/problem-based Learning	3	3		
Non destructive testing of material	s and parts (L2216)	Recitation Section (large)	1	1		
Module Responsible	Prof. Bodo Fiedler					
Admission Requirements	None					
Recommended Previous						
Knowledge						
Educational Objectives	After taking part successfully, students have reached the	e following learning results				
Professional Competence						
Knowledge						
Skills						
Personal Competence						
Social Competence						
Autonomy						
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84					
Credit points	6					
Course achievement	None					
Examination	Written elaboration					
Examination duration and	Written document about theory and praxis					
scale						
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Ele	ective Compulsory				
Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Ele	ective Compulsory				
	Civil Engineering: Specialisation Geotechnical Engineering	g: Elective Compulsory				
	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory					
	Civil Engineering: Specialisation Structural Engineering:	Elective Compulsory				
	Civil Engineering: Specialisation Structural Engineering:	Elective Compulsory				
	Civil Engineering: Specialisation Water and Traffic: Electi	ve Compulsory				
	Civil Engineering: Specialisation Water and Traffic: Electi	ve Compulsory				
	Materials Science: Specialisation Engineering Materials: I	Elective Compulsory				

Course L2215: Non destructi	ve testing of materials and parts			
Тур	Lecture			
Hrs/wk	2			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Marcus Rutner, Prof. Robert Meißner			
Language	DE/EN			
Cycle	WiSe			
Content	This strongly interdisciplinary lecture and practical course is offered to Masterstudents who are interesed to learn about an			
	important field across engineering and material science industries, i.e. nondestructive testing of materials and parts.			
	Interdisciplinary approaches and thinking becomes more and more important since many problems extend into various disciplines,			
	hence, can only be solved through interdisciplinary thinking and collaboration. Accordingly, this module combines the efforts of 4			
different disciplines, i.e. mechanical engineering, civil engineering, materials science and computer scier				
electrical engineering. Nondestructive testing (NDT) is the process of inspecting, testing, and evaluating materials, pa				
assemblies to understand properties and defects without causing damage to the material or part. This scientific approach e				
	to make intrinsic material and component characteristics visible. Hence, the approach links detection approaches (e.g. linear and			
	nonlinear acoustic methods, ultrasonic testing, Magnetic Particle Testing, thermo-chemical methods, etc.) with material physics			
	and the mechanics of components, further, with evaluation, interpretation, big data management, transmission of data, and			
	cybersecurity. The module embraces a lecture and a practical course. Contents of the lecture are NTD technologies and their			
	theory behind, evaluation, transmission of data, while the students will apply the NDT technologies during the practical course in			
	the experimental test halls and labs at TUHH. Lecture and practical course split into the major themes: A) Detection: Theory and			
	Practice B) Evaluation of Data: Theory and Practice C) Data Acquisition and Transmission with Wireless, Batteryless Sensor			
	Devices:Theory and Practice			
Literature				

Course L2217: Non destructive testing of materials and parts			
Тур	Project-/problem-based Learning		
Hrs/wk	3		
CP	3		
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Prof. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Marcus Rutner, Prof. Robert Meißner		
Language	DE/EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L2216: Non destructi	ve testing of materials and parts			
Тур	Recitation Section (large)			
Hrs/wk	1			
CP	1			
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14			
Lecturer	Prof. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Marcus Rutner, Prof. Robert Meißner			
Language	DE/EN			
Cycle	WiSe			
Content	This strongly interdisciplinary lecture and practical course is offered to Masterstudents who are interesed to learn about an			
	important field across engineering and material science industries, i.e. nondestructive testing of materials and parts.			
	Interdisciplinary approaches and thinking becomes more and more important since many problems extend into various disciplines,			
hence, can only be solved through interdisciplinary thinking and collaboration. Accordingly, this module combines the				
different disciplines, i.e. mechanical engineering, civil engineering, materials science and computer science with a t				
electrical engineering. Nondestructive testing (NDT) is the process of inspecting, testing, and evaluating materials, parts				
assemblies to understand properties and defects without causing damage to the material or part. This scientific approach ena				
	to make intrinsic material and component characteristics visible. Hence, the approach links detection approaches (e.g. linear and			
	nonlinear acoustic methods, ultrasonic testing, Magnetic Particle Testing, thermo-chemical methods, etc.) with material physics			
	and the mechanics of components, further, with evaluation, interpretation, big data management, transmission of data, and			
	cybersecurity. The module embraces a lecture and a practical course. Contents of the lecture are NTD technologies and their			
	theory behind, evaluation, transmission of data, while the students will apply the NDT technologies during the practical course in			
	the experimental test halls and labs at TUHH. Lecture and practical course split into the major themes: A) Detection: Theory and			
	Practice B) Evaluation of Data: Theory and Practice C) Data Acquisition and Transmission with Wireless, Batteryless Sensor			
	Devices:Theory and Practice			
Literature				

Module M0581: Wate	r Protection			
Courses				
Title		Тур	Hrs/wk	СР
Water Protection and Wastewater	lanagement (L0226)	Lecture	3	3
Water Protection and Wastewater I	Management (L2008)	Project Seminar	3	3
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous	 Basic knowledge in water management; 			
Kilowiedge	 Good knowledge in urban drainage; 			
	 Good knowledge of wastewater treatment 	techniques;		
	 Good knowledge of pollutants (e.g. COD, E 	3OD, TS, N, P) and their properties;		
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge	The students can describe the basic principles of	the regulatory framework related to the i	nternational and Eu	ropean water sector
	They can explain limnological processes, subst	ance cycles and water morphology in d	etail. They are able	e to assess complex
	problems related to water protection, such as	ecosystem service and wastewater treatr	nent with a special	focus on innovative
	solutions, remediation measures as well as conce	eptual approaches.		
Skills	Students can accurately assess current problem	s and situations in a country-specific or lo	ocal context. They o	an suggest concrete
	actions to contribute to the planning of tomor	row's urban water cycle. Furthermore, tl	ney can suggest a	opropriate technical
	administrative and legislative solutions to solve t	hese problems.		
Personal Competence				
Social Competence	The students can work together in international	groups.		
	-			
Autonomy	Students are able to organize their work flow to	prepare presentations and discussions. T	hey can acquire an	propriate knowledge
Autonomy	by making enguiries independently.	prepare presentations and discussions.	ney can acquire ap	
Workload in Hours	Independent Study Time 96, Study Time in Lectu	re 84		
Credit points	6			
Course achievement	None			
Examination	Presentation			
Examination duration and	Term paper plus presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engin	eering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical En	gineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Enginee	ring: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffi	c: Elective Compulsory		
	Environmental Engineering: Specialisation Water	: Elective Compulsory		
	International Management and Engineering: Spe	cialisation II. Civil Engineering: Elective Co	mpulsory	
	Joint European Master in Environmental Studies	Cities and Sustainability: Specialisation W	ater: Elective Comp	ouisory
	water and Environmental Engineering: Specialis	ation Cities: Elective Compulsory		
	Water and Environmental Engineering. Specialise	ation Environment: Compulsory		
		and a compulsory		

Course L0226: Water Protect	tion and Wastewater Management
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	WiSe
Content	 The lecture focusses on: Regulatory Framework (e.g. WFD) Main instruments for the water management and protection In depth knowledge of relevant measures of water pollution control Urban drainage, treatment options in different regions on the world Rainwater management, improved management of heavy rainfalls, downpours, rainwater harvesting, rainwater infiltration Case Studies and Field Trips
Literature	 The literature listed below is available in the library of the TUHH. Water and wastewater technology Hammer, M. J. 1., & . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Education International. Water and wastewater engineering : design principles and practice: Davis, M. L. 1. (2011) New York, NY: McGraw-Hill. Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ.

Course L2008: Water Protection and Wastewater Management			
Тур	Project Seminar		
Hrs/wk	3		
СР	3		
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Prof. Ralf Otterpohl		
Language	EN		
Cycle	WiSe		
Content			
Literature			

Module M0595: Exam	ination of Materials, Structural Co	ndition and Damages		
Courses				
Title		Тур	Hrs/wk	СР
Examination of Materials, Structura	al Condition and Damages (L0260)	Lecture	3	4
Examination of Materials, Structura		Recitation Section (Smail)	1	Z
Module Responsible				
Admission Requirements	None		de Duildine M	stariala and Duildian
Recommended Previous	Basic knowledge about building materials or m	aterial science, for example by the modu	ne Building M	aterials and Building
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence	Alter taking part successfully, students have reach			
Knowledge	The students are able to describe the rules for tra	ding use and marking of construction proc	lucts in Germa	ny They know which
Kilowieuge	The students are able to describe the rules for trading, use and marking of construction products in Germany. They know which methods for the testing of building material properties are usable and know the limitations and characterics of the most important testing methods.			
Skills	The students are able to responsibly discover the rules for trading and using of building products in Germany. They are able to chose suitable methods for the testing and inspection of construction products, the examination of damages an the examination of the structural conditions of buildings. They are able to conclude from symptons to the cause of damages. The are able to describe an examination in form of a test report or expert opinion.			
Personal Competence Social Competence	The students can describe the different roles of m framework of material testing. They can describe t	nanufacturers as well as testing, supervisor the different roles of the participants in legal	y and certificat proceedings.	tion bodies within the
Autonomy	The students are able to make the timing and the o	operation steps to learn the specialist knowle	edge of a very	extensive field.
Workload in Hours	Independent Study Time 124, Study Time in Lectur	e 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Enginee	ring: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engin	neering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering	g: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic:	Elective Compulsory		
	International Management and Engineering: Specia	lisation II. Civil Engineering: Elective Compu	llsory	
	Materials Science: Specialisation Engineering Mate	rials: Elective Compulsory		

Course L0260: Examination of Materials, Structural Condition and Damages Typ Lecture Lecture 3 OP 4 Workload in Hours Independent Study Time 78, Study Time in Lecture 42 Lecture Prof. Frank Schmidt-Döhl Language DE Content Materials testing and marking process of construction products, testing methods for building materials and structures, testing reports and expert opinions, describing the condition of a structure, from symptons to the cause of damages Literature Frank Schmidt-Döhl: Materialprüfung im Bauwesen. Fraunhofer irb-Verlag, Stuttgart, 2013.

Course L0261: Examination of Materials, Structural Condition and Damages					
Тур	Recitation Section (small)				
Hrs/wk					
CP	2				
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14				
Lecturer	of. Frank Schmidt-Döhl				
Language	DE				
Cycle	WiSe				
Content	See interlocking course				
Literature	See interlocking course				

Module M0619: Waste	e Treatment Techn	ologies				
Courses						
Title				Тур	Hrs/wk	СР
Waste and Environmental Chemist	ry (L0328)			Practical Course	2	2
Biological Waste Treatment (L0318)			Project-/problem-based Learning	3	4
Module Responsible	Prof. Kerstin Kuchta					
Admission Requirements	None					
Recommended Previous	chemical and biological ba	sics				
Knowledge						
Educational Objectives	After taking part successfu	Illy, students have re	eached the followi	ng learning results		
Professional Competence						
Knowledge	The module aims possess	knowledge concerni	ng the planning of	biological waste treatment plan	ts. Students ar	e able to explain the
	design and layout of anaer	obic and aerobic wa	ste treatment pla	nts in detail, describe different t	echniques for v	waste gas treatment
	plants for biological waste	treatment plants an	d explain different	t methods for waste analytics.		
<i>CL 11</i>	- 1					d
SKIIIS	The students are able to d	e students can rech	on of design and is	ayout of plants. They can critical	ly evaluate tec	chniques and quality
	and plan additional tests	They are capable of	reflecting and evaluation	luating findings in the group		given in der module
			i chicecung and era			
Personal Competence						
Social Competence	Students can participate i	n subject-specific ar	nd interdisciplinary	/ discussions, develop cooperate	ed solutions ar	nd defend their own
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	work results in front of o	thers and promote	the scientific dev	elopment in front of colleagues	. Furthermore,	they can give and
	accept professional constr	uctive criticism.				
Autonomy	Students can independent	ly tap knowledge fr	om literature, bus	iness or test reports and transfo	orm it to the co	ourse projects. They
	are capable, in consultatio	n with supervisors a	s well as in the int	erim presentation, to assess the	ir learning leve	el and define further
	steps on this basis. Furthe	ermore, they can de	fine targets for ne	ew application-or research-orien	ted duties in a	accordance with the
	potential social, economic	and cultural impact.				
		10 CL 4 The 14				
Credit points	independent Study Time I	10, Study Time in Le	ecture 70			
Course achievement	Compulsory Bonus For	n	Description			
course acmevement	Yes None Sub	ject theoretical	and			
	pra	ctical work				
Examination	Presentation					
Examination duration and	Elaboration and Presentati	on (15-25 minutes ir	n groups)			
scale						
Assignment for the	Civil Engineering: Specialis	ation Structural Eng	ineering: Elective	Compulsory		
Following Curricula	Civil Engineering: Specialis	ation Geotechnical I	Engineering: Elect	ive Compulsory		
	Civil Engineering: Specialis	ation Coastal Engine	eering: Elective Co	ompulsory		
	Civil Engineering: Specialis	ation Water and Tra	ffic: Elective Com	pulsory		
	Energy and Environmental	Engineering: Specia	lisation Environm	ental Engineering: Elective Com	oulsory	
	Environmental Engineering	g: Core Qualification:	Compulsory	argu and Environmental Engines	ring, Elective (Compulson
	International Management	and Engineering: Sp nvironmental Studie	s - Cities and Sust	ainability: Specialisation Energy	Flective Com	Lompulsory
	Water and Environmental	Engineering: Special	isation Cities. Flee	tive Compulsory	Liective Comp	Juisory
	Water and Environmental	Engineering: Special	isation Environme	nt: Elective Compulsory		
		5 ··· ·5· ·p· ·o		· · · · · · · · · · · · · · · · · · ·		

Course L0328: Waste and Environmental Chemistry				
Тур	Practical Course			
Hrs/wk	2			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Kerstin Kuchta			
Language	DE/EN			
Cycle	WiSe			
Content	The participants are divided into groups. Each group prepares a transcript on the experiment performed, which is then used as basis for discussing the results and to evaluate the performance of the group and the individual student. In some experiments the test procedure and the results are presented in seminar form, accompanied by discussion and results evaluation. Experiments ar e.g. Screening and particle size determination Fos/Tac AAS Chalorific value			
Literature	Scripte			

Course L0318: Biological Waste Treatment				
Тур	Project-/problem-based Learning			
Hrs/wk	3			
СР	4			
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42			
Lecturer	Prof. Kerstin Kuchta			
Language	EN			
Cycle	WiSe			
Content	 Introduction biological basics determination process specific material characterization aerobic degradation (Composting, stabilization) anaerobic degradation (Biogas production, fermentation) Technical layout and process design Flue gas treatment Plant design practical phase 			
Literature				

Courses Typ Hrs/wk CP Seminar 1 1 1 Structural Concrete Members (L0577) Lecture 2 3 Structural Concrete Members (L0577) Lecture 2 3 Module Responsible Prof. Gunter Rombach Admission Requirements None Module Responsible Prof. Gunter Rombach Admission Requirements None Recommended Previous Basics of structural analysis, conception and dimensioning of structural concrete Modules: Reinforced Concrete Structures I+II, Structural Analysis I+II, Mechanics I+II Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence Knowledge The students broaden their skills in structural engineering, especially in the field of buildings (houses, roofs, halls). They dispose the knowledge for the conception and dimensioning to to practical problems of structural engineering. Skills The students are able to apply procedures of the conception and dimensioning to to practical problems of structural engineering. Personal Competence Social Competence The students are able to otrain results of high quality in teamwork. Autonomy The students are able to carray out complex conception and dimensioning tasks o	Module M0713: Concr	ete Structures	;				
Title Typ Hrs/wk CP Concrete Structures (L0579) Seminar 1 1 Structural Concrete Members (L0577) Lecture 2 3 Module Responsible Prof. Günter Rombach Admission Requirements None Recommended Previous Basics of structural analysis, conception and dimensioning of structural concrete Modules: Reinforced Concrete Structures I+II, Structural Analysis I+II, Mechanics I+II Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence Knowledge The students are able to apply procedures of the conception and dimensioning to to practical problems of structural engineering, especially in the field of buildings (houses, roots, halls). They dispose the knowledge for the conception and design of concrete buildings and structural engineering results Professional Competence Social Competence Social Competence Variant Concrete The students are able to apply procedures of the conception and dimensioning to to practical problems of structural engineering. Personal Competence Social Competence The students are able to obtain results of high quality in teamwork. Workload in Hours Independent Study Time 110, Study Time in Lecture 70 Ceredit point 6 Course	Courses						
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Structural Concrete Members (L0577) Lecture 2 3 Structural Concrete Members (L0578) Recitation Section (large) 2 2 Module Responsible Prof. Gunter Rombach Recitation Section (large) 2 2 Admission Requirements None Basics of structural analysis, conception and dimensioning of structural concrete Modules: Reinforced Concrete Structures I+II, Structural Analysis I+II, Mechanics I+II Modules: Reinforced Concrete Structures I+II, Structural Analysis I+II, Mechanics I+II Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence <i>Knowledge</i> The students broaden their skills in structural engineering, especially in the field of buildings (houses, roofs, halls). They dispose the knowledge for the conception and design of concrete buildings and structural members that are often used. <i>Skills</i> The students are able to apply procedures of the conception and dimensioning to to practical problems of structural engineering rescution. Moreover, they can make design and construction sketches and fraw up technical descriptions. Personal Competence Social Competence/ The students are able to carry out complex conception and dimensioning tasks of structures under the guidance of tutors. Workload in Hours Independent Study Time 110, Study Time In Lecture 70 E Course achievement Sone	Concrete Structures (L0579)				Seminar	1	1
Structural Concrete Members (LDS7) Reclation Section (large) 2 2 Module Responsible Prof. Günter Rombach Admission Requirements None Recommended Previous Basics of structural analysis, conception and dimensioning of structural concrete Modules: Reinforced Concrete Structures I+II, Structural Analysis I+II, Mechanics I+II Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence Knowledge The students broaden their skills in structural engineering, especially in the field of buildings (houses, roofs, halls). They dispose the knowledge for the conception and design of concrete buildings and structural members that are often used. Skills The students are able to apply procedures of the conception and dimensioning to to practical problems of structural engineering. Personal Competence Social Competence The students are able to obtain results of high quality in teamwork. Autonomy The students are able to obtain results of high quality in teamwork. Autonomy Workload in Hours Independent Study Time 110, Study Time in Lecture 70 Course achievement Yes None Presentation Es worden 2 Referate ausgegeben Examination duration and 1/20 minutes Salistion Structural Engineering: Compulsory	Structural Concrete Members (L057	77)			Lecture	2	3
Module Responsible Prof. Gonter Rombach Admission Requirements None Recommended Previous Basics of structural analysis, conception and dimensioning of structural concrete Knowledge Modules: Reinforced Concrete Structures I+II, Structural Analysis I+II, Mechanics I+II Educational Objectives After taking part successfully, students have reached the following learning results Professional Competence Knowledge Knowledge The students broaden their skills in structural engineering, especially in the field of buildings (houses, roofs, halls). They dispose the knowledge for the conception and design of concrete buildings and structural members that are often used. Skills The students are able to apply procedures of the conception and dimensioning to to practical problems of structural engineering execution. Moreover, they can make design and construction sketches and draw up technical descriptions. Personal Competence Social Competence Social Competence The students are able to obtain results of high quality in teamwork. Autonomy The students are able to aprox out complex conception and dimensioning tasks of structures under the guidance of tutors. Workload in Hours Independent Study Time 110, Study Time in Lecture 70 Course achievement Course achievement Yes None Presentation Examination <	Structural Concrete Members (L057	(8)			Recitation Section (large)	2	2
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Social Competence The students are able to obtain results of high quality in teamwork. Autonomy The students are able to carry out complex conception and dimensioning tasks of structures under the guidance of tutors. Workload in Hours Independent Study Time 110, Study Time in Lecture 70 Credit points 6 Course achievement Compulsory Bonus Form Presentation Yes None Presentation Kritten exam Examination Written exam Examination duration and scale 120 minutes Following Curricula Civil Engineering: Specialisation Structural Engineering: Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Civil Engineering: Specialisation II. Civil Engineering: Elective Compulsory	Personal Competence						
Autonomy The students are able to carry out complex conception and dimensioning tasks of structures under the guidance of tutors. Workload in Hours Independent Study Time 110, Study Time in Lecture 70 Credit points 6 Course achievement Compulsory Bonus Form Description Yes None Presentation Es werden 2 Referate ausgegeben Examination duration and scale 120 minutes Independent Study Time Independent Study Time Independent Study Assignment for the Following Curricula Civil Engineering: Specialisation Structural Engineering: Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory Civil Engineering: Specialisation II. Civil Engineering: Elective Compulsory	Social Competence	The students are able to obtain results of high quality in teamwork.					
Workload in Hours Independent Study Time 110, Study Time in Lecture 70 Credit points 6 Course achievement Compulsory Bonus Form Description Yes None Presentation Es werden 2 Referate ausgegeben Examination duration and scale Unitten exam Estamination Gotton Compulsory Civil Engineering: Specialisation Structural Engineering: Compulsory Assignment for the Following Curricula Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Independent of the Civil Engineering: Specialisation Mater and Traffic: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory	Autonomy	The students are able to carry out complex conception and dimensioning tasks of structures under the guidance of tutors.					
Workload in Hours Independent Study Time 110, Study Time in Lecture 70 Credit points 6 Course achievement Compulsory Bonus Form Description Yes None Presentation Es werden 2 Referate ausgegeben Examination duration and scale 120 minutes Es Scale Assignment for the Following Curricula Civil Engineering: Specialisation Structural Engineering: Compulsory Compulsory Following Curricula Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory					5		
Credit points 6 Course achievement Compulsory Bonus Form Description Yes None Presentation Es werden 2 Referate ausgegeben Examination Written exam Examination duration and scale 120 minutes Following Curricula Civil Engineering: Specialisation Structural Engineering: Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory	Workload in Hours	Independent Study T	ime 110, Study Time	in Lecture 70			
Course achievement Compulsory Bonus Form Description Yes None Presentation Es werden 2 Referate ausgegeben Examination Written exam Examination duration and scale 120 minutes Following Curricula Civil Engineering: Specialisation Structural Engineering: Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory	Credit points	6					
Yes None Presentation Es werden 2 Referate ausgegeben Examination Written exam Examination duration and scale 120 minutes Assignment for the Following Curricula Civil Engineering: Specialisation Structural Engineering: Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory	Course achievement	Compulsory Bonus	Form	Description			
Examination Written exam Examination duration and scale 120 minutes Assignment for the Following Curricula Civil Engineering: Specialisation Structural Engineering: Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory		res None	Presentation	Es werden 2	Referate ausgegeben		
Examination duration and scale 120 minutes Assignment for the Following Curricula Civil Engineering: Specialisation Structural Engineering: Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory	Examination	Written exam					
scale Assignment for the Civil Engineering: Specialisation Structural Engineering: Compulsory Following Curricula Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory	Examination duration and	120 minutes					
Assignment for the Civil Engineering: Specialisation Structural Engineering: Compulsory Following Curricula Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory	scale						
Following Curricula Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory	Assignment for the	Civil Engineering: Sp	ecialisation Structura	Engineering: Compuls	sory		
Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory	Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory					
Civil Engineering: Specialisation Water and Traffic: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory		Civil Engineering: Sp	ecialisation Coastal E	ngineering: Elective Co	ompulsory		
International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory		Civil Engineering: Sp	ecialisation Water and	d Traffic: Elective Com	pulsory		
		International Manage	ement and Engineerin	g: Specialisation II. Civ	il Engineering: Elective Cor	npulsory	

Course L0579: Concrete Structures			
Тур	Seminar		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Günter Rombach		
Language	DE		
Cycle	WiSe		
Content	With help of a project teamwork the subjects of the course "Concrete Structures" is practiced, discussed and presented.		
Literature	- Projektbezogene Unterlagen werden abgegeben.		
Course L0577: Structural Cor	ncrete Members		
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Тур	Lecture		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Günter Rombach		
Language	DE		
Cycle	WiSe		
Content	 skyscrapers: structural elements actions on structrues bracing systems design orf slabs (line and point supported plates and floor slabs) membranes and deep beams folded plates and shells truss models reinforced and prestressed members 		
Literature	 Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003 Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012 Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalender 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992 Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin 1973 Schlaich J.; Schäfer K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721ff, Verlag Ernst & Sohn, Berlin, 1998 Dames KH.: Rohbauzeichnungen Bewehrungszeichnungen. Bauverlag, Wiesbaden 1997 		

Course L0578: Structural Concrete Members		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Günter Rombach	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0722: Comp	outation	al Ana	lysis of Concre	ete Structures			
Courses							
Title					Тур	Hrs/wk	СР
Computational Analysis of Concrete	e Structures	(L0598)			Lecture	2	3
Computational Analysis of Concrete	e Structures	(L0599)			Recitation Section (large)	1	1
FE-Modeling of Concrete Structures	s (L0600)				Project-/problem-based Learning	2	2
Module Responsible	Prof. Günte	er Romba	ch				
Admission Requirements	None						
Recommended Previous	Basic know	ledge in	structural analysis ar	nd design of reinforced of	concrete structures (beams, slab	s, shear walls).
Knowledge	Lectures '	Concrete	Structures I und II'				
	Lectures '	Structura	I Analysis I and II'				
	Lecture 'Co	oncrete S	tructures'				
Educational Objectives	After takin	g part su	ccessfully, students h	ave reached the followi	ng learning results		
Professional Competence							
Knowledge	The studer	nts know	the problems of nume	erical modeling and des	ign of an arbitrary concrete strue	cture.	
Skills	The studer	The students can model and design an arbitrary concrete structure by means of a finite element software package.					
Personal Competence							
Social Competence	The studer	nts can m	odel and design in te	amwork a real concrete	structure by means of a finite e	lement softwa	ire package.
			5		,		
Autonomy	The studer	The students can model and design a real concrete structure based on a finite element software package and discuss the problems			discuss the problems		
	and results	s with oth	er students.				
Workload in Hours	Independe	nt Study	Time 110, Study Time	e in Lecture 70			
Credit points	6		-				
Course achievement	Compulsory	Bonus	Form	Description			
	Yes	None	Attestation	Am Ende de	es Semster ist ein Tragsystem	n mit dem P	echenprogramm zu
				modellieren			
	Yes	None	Excercises	Es ist ein Tra	gsystem mit TEDDY zu modellier	ren	
Examination	Oral exam						
Examination duration and	45 min						
scale							
Assignment for the	Civil Engin	eering: S	pecialisation Structur	al Engineering: Elective	Compulsory		
Following Curricula	Civil Engin	eering: S	pecialisation Geotech	inical Engineering: Elect	ive Compulsory		
	Civil Engin	eering: S	pecialisation Coastal	Engineering: Elective Co	ompulsory		
	Civil Engin	eering: S	pecialisation Water a	nd Traffic: Elective Com	pulsory		

Course L0598: Computationa	I Analysis of Concrete Structures
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	WiSe
Content	 Modeling of beam and truss structures Discontinuity regions, like frame corners, openings, shear walls with large openings Bracing of high-rise buildings Modeling of bridges Nonlinear analysis Finite-Elemente-analysis of slabs: support conditions, singularity regions Finite-Elemente-Berechnungen of shear walls and deep beams: support condition, design Coupled systems Modeling of slab supported on beams Shell structures 3D building models Nonlinear analysis of slabs and shells Documentation
Literature	 Vorlesungsumdruck Rombach, G.A. (2007): Anwendung der Finite-Elemente-Methode im Betonbau. 2. Auflage, Verlag Ernst & Sohn, Berlin Rombach G.A. (2011): Finite-Element Design of Concrete Structures, 2nd edition, ICE publishing Hartmann, F., Katz, C. (2002): Statik mit finiten Elementen. Springer, Berlin

Course L0599: Computational Analysis of Concrete Structures		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Günter Rombach	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0600: FE-Modeling of	of Concrete Structures
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Lukas Henze
Language	DE
Cycle	WiSe
Content	Finite Element Modeling and computational design of concrete structures by 'SOFiSTiK'
Literature	 Rombach G.: Anwendung der Finite - Elemente - Methode im Betonbau. 2. Auflage. Verlag Ernst & Sohn, Berlin, 2007 Rombach G.: Finite-Element Design of Concrete Structures. 2nd edition, ICE Publishing, London, 2011, ISBN 0 7277 32749 Rombach G.: EDV-unterstützte Berechnungen im Stahlbetonbau. in: "Stahlbetonbau aktuell 2014" (ed. Gorris A., Hegger J., Mark P.), Berlin 2014 (S. C1C.36)

Module M0923: Integ	rated Transportation Planning
Courses	
Title	Typ Hrs/wk CP
Integrated Transportation Planning	(L1068) Project-/problem-based Learning 4 6
Module Responsible	Prof. Carsten Gertz
Admission Requirements	None
Recommended Previous	some knowledge of transport planning, e.g. through taking the undergraduate class "Transport Planning and Traffic Engineerin
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to:
	 describe interdependencies between land-use/location choice and transportation/mobility behaviour explain and evaluate the social, ecological and economic effects of transport and land-use policy measures. relate current issues in the area of integrated transport planning and formulate an opinion on them.
Skills	 Students are able to: quantify important parameters, which influence travel demand or are influenced by it. comprehensively examine a pre-defined or self-selected topic from a transportation studies perspective and document the results in accordance with scientific conventions.
Personal Competence Social Competence	 Students are able to: provide feedback on topical contents and their teaching. constructively handle feedback on their own work. produce results in group work and document these.
Autonomy	 Students are able to: assess potential consequences of their future professional activities independently plan working on a pre-defined project topic, acquire the necessary knowledge and use appropriate means fo its execution.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and	written assignment with presentation during the semester
scale	
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory
	Civil Engineering: Specialisation Water and Traffic: Compulsory
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective Compulsory
	Water and Environmental Engineering: Specialisation Water: Elective Compulsory
	Water and Environmental Engineering: Specialisation Environment: Elective Compulsory
	water and Environmental Engineering: Specialisation Cities: Compulsory

Course L1068: Integrated Tra	ansportation Planning
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Carsten Gertz, Dr. Philine Gaffron, Jacqueline Bianca Maaß
Language	DE
Cycle	WiSe
Content	The course will provide students with an understanding of interdependencies between land-use and transportation. Specific topics
	 include a.o.: interactions between transport and the environment and consequent limitations characteristics of integrated planning complex planning processes interdependencies of location choice and mobility behaviour transport and land-use policies project on current issues in transportation studies
Literature	Kutter, Eckhard (2005) Entwicklung innovativer Verkehrsstrategien für die mobile Gesellschaft. Erich Schmidt Verlag. Berlin. Bracher, Tilman u. a. (Hrsg.) (68. Ergänzung 2013) Handbuch der kommunalen Verkehrsplanung. Herbert Wichmann Verlag. Berlin, Offenbach. (Loseblattsammlung mit kontinuierlichen Ergänzungen)

Module M0963: Steel	and Composite Structures			
Courses				
Title		Тур	Hrs/wk	СР
Steel and Composite Structures (L1	204)	Lecture	2	2
Steel and Composite Structures (LI	.205)	Recitation Section (large)	2	2
Steel Bridges (L1097)		Lecture	2	2
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
Recommended Previous	Basics of steel construction (i.e. Steel Structures I and II, BUBC)			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	After successful completition, students can			
	 describe the phenomenon of local buckling 			
	evelsion warping torsion			
	explain warping torsion			
	Inustrate the behaviour of composite structures			
	 specify the principles in design of composite structures 			
	 sketch the contructions of steel and composite bridges 			
Skills	After successful participation students are able to			
	 check stiffened and unstiffened plated structures 			
	 recognize and verify warping tosion in strucures 			
	 design composite structures 			
	 design bridges and o perform the detailing 			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96. Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Compul	sory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elect	tive Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective C	ompulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Com	pulsory		
	International Management and Engineering: Specialisation II. Ci	vil Engineering: Elective Com	oulsorv	
		5		

Course L1204: Steel and Composite Structures		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Marcus Rutner	
Language	DE	
Cycle	WiSe	
Content	 Local-buckling of plated structures Warping torsion Composite-girders, -columns, -slabs, -bridges Principles in composite constructions Bridge-design and -construction 	
Literature	Petersen, C.: Stahlbau, 4.Auflage 2013, Springer-Vieweg Verlag Minnert, J. Wagenknecht, G.: Verbundbau-Praxis - Berechnung und Konstruktion nach Eurocode 4, 2.Auflage 2013, Bauwerk Beuth Verlag	

Course L1205: Steel and Composite Structures		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Marcus Rutner	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L1097: Steel Bridges	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Jörg Ahlgrimm
Language	DE
Cycle	WiSe
Content	Lecture Contents ,Steel Bridge Construction
	Dring. Jorg Anigrimm
	- From tendering and contracting to completion - the development of a steel bridge
	- Contents of a bridge static - structural details, examples of analysis in detail:
	-> effective width in regard to the longitudinal stiffeners
	-> Bearing point, bearing stiffener
	-> Crossbeam breakthrough, crossbeam reinforcement
	-> Analysis of the Rib-to-Floorbeam (RF) connection (web-tooth of the floorbeam between trapezoidal shaped Ribs)
	- Steel grades, -designation, testing methods and approval certificates
	- Nondestructive weld inspecting
	- Corrosion protection
	- Bridge bearing - types, format, function, dimensioning, installation
	- Expansion Joints
	- Oscillation of bridge hangers and cables - oscillation damper
	- Opening bridges- Detailed reviews to different assembling procedures and - implements
	- Selective damage events
	Requirements: Basic knowledge in the calculation, dimensioning, and construction of structural elements and joints of constructional steelwork
Literature	
	Herbert Schmidt, Ulrich Schulte, Rainer Zwätz, Lothar Bär:
	Austunrung von Stahlbauten
	Petersen, Christian: Stahlbau, Abschnitt Brückenbau
	 Ahlgrimm, J., Lohrer, I.: Erneuerung der Eisenbahnüberführung in Fulda-Horas über die Fulda, Stahlbau 74 (2005), Heft 2, S. 114

Module M0967: Study	Work Harbour and Coastal Engineering
Courses	
Title	Typ Hrs/wk CP
Module Responsible	Prof. Peter Fröhle
Admission Requirements	None
Recommended Previous	Subjects of the Port and Coastal Engineering specialisation.
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students are able to demonstrate their detailed knowledge in the field of port and coastal engineering. They can exemplify th state of technology and application and discuss critically in the context of actual problems and general conditions of science an society.
	The students can develop solving strategies and approaches for fundamental and practical problems in port and coasta engineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view point of science and society.
Skills	Scientific work techniques that are used can be described and critically reviewed. The students are able to independently select methods for the project work and to justify this choice. They can explain how thes methods relate to the field of work and how the context of application has to be adjusted. General findings and further developments may essentially be outlined.
Personal Competence	
Social Competence	The students are able to condense the relevance and the structure of the project work, the work steps and the sub-problems for the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to the colleagues.
Autonomy	The students are capable of independently planning and documenting the work steps and procedures while considering the give deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain feedbac from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology.
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0
Credit points	6
Course achievement	None
Examination	Study work
Examination duration and scale	The number of pages depends on the task.
Assignment for the Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Compulsory

Module M0969: Selected Topics in Civil Engineering Courses Title Тур Hrs/wk CP 2 Eraonomics (L0653) Lecture 3 Analysis of Offshore Structures (L1867) Lecture 1 1 Excellence in International Project Delivery (L2387) Integrated Lecture 2 2 Design of Prefabricated Concrete Structures (L0596) Lecture 1 1 Design of Prefabricated Concrete Structures (L0597) Recitation Section (large) 1 1 Forum I - Geotechnics and Construction Management (L1634) Seminar 1 1 Forum II - Geotechnics and Construction Management (L1635) Seminar 1 1 2 3 Geotechnical Engineering Design (L2447) Lecture Timber Structures (L1151) Seminar 2 2 Innovative Timber Construction (L2666) Lecture 2 3 Glass Structures (L1152) Lecture 2 2 Glass Structures (L1447) Recitation Section (large) 1 1 Testing and non-destructive examination of concrete members (L2725) Project-/problem-based Learning 2 2 Special topics of civil engineering 1CP (L2378) 1 1 Special topics of civil engineering 2 LP (L2379) 2 2 Special topics of civil engineering 3 LP (L2380) 3 3 Structural Design (L2789) Seminar 2 2 Module Responsible Prof. Frank Schmidt-Döhl **Admission Requirements** None **Recommended Previous** none Knowledge **Educational Objectives** After taking part successfully, students have reached the following learning results **Professional Competence** Knowledae • Students are able to find their way through selected special areas within civil and structural engineering. • Students are able to explain basic models and procedures in selected special areas of civil and structural engineering. Students are able to interrelate scientific and technical knowledge. Skills • Students are able to apply basic methods in selected areas of civil and structural engineering. **Personal Competence** Social Competence Autonomy • Students can chose independently, in which fields they want to deepen their knowledge and skills through the election of courses. Workload in Hours Depends on choice of courses **Credit points** 6 Assignment for the Civil Engineering: Specialisation Structural Engineering: Elective Compulsory **Following Curricula** Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory

Course L0653: Ergonomics	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and	30 min
scale	
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	

Module Manual M.Sc. "Civil Engineering"

Course L1867: Analysis of Of	ifshore Structures
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and	30 min
scale	
Lecturer	Dr. Said Fawad Mohammadi
Language	DE/EN
Cycle	SoSe
Content	Topic 1: Types of Offshore Structures, Fixed and floating structures for Oil & Gas and Offshore Wind industry
	Topic 2: Wave Forces, Morisons equation
	Topic 3: Irregular Seastates, Power spectrum and application of FFT
	Topic 4: Additional Environmental Forces, wind spectra, current forces
	Topic 5: Linear-Time-Invariant Systems, response of an LTI-system in frequency domain
	Topic 6: Tubular Welded Connections, stress concentration factors, weld geometry
	Topic 7: Introduction to Fracture Mechanics, criteria for fracture initiation and crack growth
	Topic 8: Time and Frequency Domain Fatigue Analyses, rainflow counting, application of LTI-systems for frequency domain fatigue
	Topic 9: Offshore Installation and Exam, installation of structures, pile driving, pipe laying techniques
Literature	Chakrabarti, Handbook of Offshore Engineering, 2005
	Sarpkaya, Wave Forces on Offshore Structures, 2010
	Faltinsen, Sea Loads on Ships and Offshore Structures, 1998
	Sorensen, Basic Coastal Engineering, 2006
	Dowling, Mechanical Behavior of Materials, 2007
	Haibach, Betriebsfestigkeit, 2006
	Marshall, Design of Welded Tubular Connections, 1992
	Newland, Random vibrations, spectral and wavelet analysis, 1993

Course L2387: Excellence in International Project Delivery	
Тур	Integrated Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	laut FSPO
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt
scale	
Lecturer	Dr. Jens Huckfeldt
Language	EN
Cycle	SoSe
Content	
Literature	

Course L0596: Design of Pre	fabricated Concrete Structures
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and	60 min
scale	
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	SoSe
Content	 application and advantages and disadvantages of precast concrete structures basics of design - precast element production - construction - tolerances elements of a warehouse design of a beam - joints design of D-regions: half joints, corbels, openings slab types - walls - facades footings: pocket and block foundations joints - connections shear design of the interface between concrete cast at different times unreinforced concrete structures
Literature	 Bachmann H., Steinle A.; Hahn V.: Bauen mit Betonfertigteilen. Betonkalender 2009, Teil I, Verlag Ernst & Sohn, Berlin Bindseil P.: Stahlbetonfertigteile. Werner Verlag, 1998 FIP: FIP Handbuch für Planung und Entwerfen von Fertigteilbauten (siehe Zeitschrift: Beton- und Fertigteiltechnik ab 3/1996) Bergmeister K.: Konstruieren von Fertigteilen. Betonkalender 2005 Teil 2, S. 163-240 Reineck KH.: Modellierung der D-Bereiche von Fertigteilen. Betonkalender 2005 Teil 2, S. 241-296 Graubner CA. et. al.: Bemessung von Fertigteilen nach DIN 1045-1. Betonkalender 2005 Teil 2, S. 297-374 Broschüren der Fachvereinigung Deutscher Betonfertigteilbau e.V. siehe: www.fdb-fertigteilbau.de www.systembauweise.de

Course L0597: Design of Prefabricated Concrete Structures	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and	Siehe korrespondierende Vorlesung
scale	
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1634: Forum I - Geotechnics and Construction Management	
Тур	Seminar
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and	30 min
scale	
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	Lectures about projects and issues with practical and scientific relevance.
Literature	

Course L1635: Forum II - Geotechnics and Construction Management	
Тур	Seminar
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and	30 min
scale	
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	SoSe
Content	Lectures about projects and issues with practical and scientific relevance.
Literature	

Course L2447: Geotechnical Engineering Design	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and	45 Min.
scale	
Lecturer	Prof. Jürgen Grabe, Dr. Tim Pucker
Language	DE
Cycle	WiSe
Content	The focus of the course is on the design of geotechnical structures. Methods and fundamental approaches for the successful processing of geotechnical designs are taught. Theoretical approaches are backed up with examples from everyday work in industry. In parallel to the theoretical content, students are given a practical task for a geotechnical design at beginning of the course, which will be worked on in small teams. In addition to the application of the already acquired technical knowledge, topics
	like realisation, construction sequence planning, cost calculation, optimisation and evaluation criteria are also part of the course. The event will be finished with the presentation of the designs.
Literature	

Course L1151: Timber Structures	
Тур	Seminar
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and	90 min
scale	
Lecturer	Prof. Torsten Faber
Language	DE
Cycle	WiSe
Content	
Literature	

Course L2666: Innovative Timber Construction	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and	45 Minuten
scale	
Lecturer	Dr. Andreas Meisel
Language	DE
Cycle	WiSe
Content	
Literature	- Blass, J.: "Ingenieurholzbau"
	- Schickhofer, G.: "BSPhandbuch: Holz-Massivbauweise in Brettsperrholz"
	- Informationsdienst Holz: div. Merkblätter und Broschüren
	- Wallner-Novak M.: Brettsperrholz Bemessung, Band 1 und 2
	- Gerner M.: "Fachwerk: Entwicklung, Instandsetzung, Neubau"
	- Meisel, A.: "Historische Dachwerke: Beurteilung, realitätsnahe statische Analyse und Instandsetzung"
	- Kempe K.: "Dokumentation Holzschädlinge"
	- Huckfeldt T.: "Hausfäule- und Bauholzpilze"

Course L1152: Glass Structures	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and	
scale	
Lecturer	Marvin Matzik
Language	DE
Cycle	WiSe
Content	Glass structures
	- Introduction of the material glass (production, refinement, material characteristic)
	- design of facades
	- facade types
	- static calculation of glazing
	- static calculation of facades
	- load bearing behavior of glazing (plate or membrane stiffness)
	- vertical / horizontal glazing with safety-related requirements
	- glass structures
	- fire safety of glass facades
	- construction physics of facades and glazing
Literature	

Course L1447: Glass Structures		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Examination Form	Mündliche Prüfung	
Examination duration and		
scale		
Lecturer	Marvin Matzik	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L2725: Testing and non-destructive examination of concrete members		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	Mündliche Prüfung	
Examination duration and	20 min	
scale		
Lecturer	Dr. Lukas Henze, Dr. Lukas Henze	
Language	DE	
Cycle	SoSe	
Content		
Literature		

Course L2378: Special topics of civil engineering 1CP	
Тур	
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	laut FSPO
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt
scale	
Lecturer	Dozenten des SD B
Language	DE
Cycle	WiSe/SoSe
Content	The course occurs only if required. The content is defined at short notice.
Literature	Die Literatur wird kurzfristig festgelegt.

Course L2379: Special topics of civil engineering 2 LP	
Тур	
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	laut FSPO
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt
scale	
Lecturer	Dozenten des SD B
Language	DE
Cycle	WiSe/SoSe
Content	The course occurs only if required. The content is defined at short notice.
Literature	Die Literatur wird kurzfristig festgelegt.

Course L2380: Special topics of civil engineering 3 LP		
Тур		
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Examination Form	laut FSPO	
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt	
scale		
Lecturer	Dozenten des SD B	
Language	DE	
Cycle	WiSe/SoSe	
Content	The course occurs only if required. The content is defined at short notice.	
Literature	Die Literatur wird kurzfristig festgelegt.	

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Course L2789: Structural De	sign
Тур	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and	20 min
scale	
Lecturer	Dr. Jan Mittelstädt
Language	DE/EN
Cycle	SoSe
Content	
Literature	[1] Structure Systems by Heino Engel, Hantje Cantz, 3rd edition (Feb 2007), ISBN-10: 3775718761
	Form and Force, Designing Efficient, Expressive Structures by Allan, E., Zalewski, W. et al, John Wiley and
	Sons; 1st edition (Sept 2009), ISBN-10: 047017465X
	[2] Peter Rice: An Engineer Imagines, ISBN-10 : 1849944237
	[3] Konrad Wachsmann and the Grapevine Structure by C. Sumi et al., Park Books (Oct 2018), ISBN-10:
	9783038601104
	[4] Manual of Multi-Story Timber Construction by Hermann Kaufmann, Stefan Krotsch, Stefan Winter, DETAIL, (June 2018) JSBN-10: 3955533948
	[5] The Art of Structural Design: A Swiss Legacy by B. Billington. Princeton University Art Museum: First Edition
	edition (Mar 2003), ISBN-10: 0300097867
	[6] Structured Lineages: Learning from Japanese Structural Design by G. Nordenson et al, The Museum of
	Modern Art (Jul 2019), ISBN-10: 1633450562
	[7] The Structure: Works of Mahendra Raj by V. Mehta, R. Mehndiretta, A. Huber, Park Books (Oct 2015),
	ISBN-10: 3038600253

Module M0997: Struc	tural Analysis - Selected Topics			
Courses				
Title		Тур	Hrs/wk	СР
Plates and Shells (L1199)		Lecture	2	2
Nonlinear Analysis of Frame Structu	ure (L1200)	Lecture	2	2
Nonlinear Analysis of Frame Structu	ure (L1201)	Recitation Section (large)	2	2
Module Responsible	Prof. Uwe Starossek			
Admission Requirements	None			
Recommended Previous	Mechanics I/II, Mathematics I/II, Differential Equations	1		
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	After successful completion of this module, students c	an explain selected elements of higher s	structural analys	is.
Skills				
SKIIIS				
	After successful completion of this module, the stude	ents are able to assess the premises a	nd the applicabi	ility of the presented
	methods of advanced structural analysis. They are abl	le to use these methods for performing s	structural analys	es.
Personal Competence				
Social Competence	Students can			
Social competence				
	 participate in subject-specific and interdisciplina 	ary discussions,		
	 defend their own work results in front of others 			
	 promote the scientific development of colleague 	es		
	 Furthermore, they can give and accept professi 	onal constructive criticism		
Autonomy	The students have the opportunity to voluntarily and i	ndependently work homework problems		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	135 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering	g: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Enginee	ring: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering:	Elective Compulsory		

Course L1199: Plates and Sh	ells		
Тур	Lecture		
Hrs/wk	2		
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Dr. Jürgen Priebe		
Language	DE		
Cycle	WiSe		
Content	Theory of plates loaded in-plane		
	 Governing equations (equilibrium, kinematics, constitutive law) Differential equation Airy stress function Plane stress / plane strain Structural behaviour of plates loaded in-plane Theory of plates in bending 		
	 Governing equations (equilibrium, kinematics, constitutive law) Differential equation Navier solution / Fourier series expansion Approximation procedures Structural behaviour of plates in bending 		
	Shell theory Phenomenona of the structural behaviour of shells Membrane and bending theory Equilibrium equations of shells of revolution Stress resultants and deformations of the spherical shell, the half spherical shell, and the cylindrical shell Stability problems (overview) Plate buckling Shell buckling		
Literature	 Basar, Y.: Krätzig, W.B. (1985): Mechanik der Flächentragwerke. Vieweg-Verlag, Braunschweig, Wiesbaden Girkmann, K. (1963): Flächentragwerke, Springer Verlag, Wien, 1963, unveränderter Nachdruck 1986 Zienkiewicz, O.C. (1977): The Finite Element Method in Enginieering Science. McGraw-Hill, London 		

Course L1200: Nonlinear Ana	alysis of Frame Structure
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	WiSe
Content	-Types of nonlinearity
	-relevance of nonlinear effects on structural analysis
	-comparison and classification of 1 st order theory, 2 nd order theory and 3 rd order theory with regard to the coverage of geometric nonlinearity
	-fundamentals of 2 nd order elasticity theory for frame structures
	-application of 2 nd order elasticity theory using finite elements: common displacement method
	-fundamentals of analytical application of 2 nd order elasticity theory: derivation and solution of differential equation
	-structurally applied methods of analytical application of 2 nd order elasticity theory: common displacement method using analytical stiffness matrix, slope-deflection method for sway and non-sway frame structures, consideration of imperfections
	1 st order plastic hinge theory
Literature	Rothert, H.; Gensichen, V. (1987): Nichtlineare Stabstatik. Springer Verlag, Berlin

Course L1201: Nonlinear Analysis of Frame Structure	
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0801: Wate	r Resources and -Supply			
Courses				
Title		Тур	Hrs/wk	СР
Chemistry of Drinking Water Treatr	ment (L0311)	Lecture	2	1
Chemistry of Drinking Water Treatr	ment (L0312)	Recitation Section (large)	1	2
Water Resource Management (L04	02)	Lecture	2	2
Water Resource Management (L04	03)	Recitation Section (small)	1	1
Module Responsible	Prof. Mathias Ernst			
Admission Requirements	None			
Recommended Previous	Knowledge of water management and the key process	ses involved in water treatment.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	Students will be able to outline key areas of conflict in water management, as well as their mutual dependence for sustainable water supply. They will understand relevant economic, environmental and social factors. Students will be able to explain and outline the organisational structures of water companies. They will be able to explain the available water treatment processes and the scope of their application.			
Skills	Students will be able to assess complex problems in drinking water production and establish solutions involving water management and technical measures. They will be able to assess the evaluation methods that can be used for this. Students will be able to carry out chemical calculations for selected treatment processes and apply generally accepted technical rules and standards to these processes.			
Personal Competence				
Social Competence	Working in a diverse group of specialists, students will be able to develop and document complex solutions for the management and treatment of drinking water. They will be able to take an appropriate professional position, for example representing user interests. They will be able to develop joint solutions in teams of diverse experts and present these solutions to others.			
Autonomy	Students will be in a position to work on a subject inde	ependently and present on this subject.		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84	ŀ		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min (chemistry) + presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineerin	g: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Enginee	ring: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Co	mpulsory		
	Civil Engineering: Specialisation Coastal Engineering:	Elective Compulsory		
	International Management and Engineering: Specialis	ation II. Energy and Environmental Engir	neering: Elective	Compulsory
	Water and Environmental Engineering: Specialisation	Water: Compulsory		
	Water and Environmental Engineering: Specialisation	Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Cities: Elective Compulsory		

Course L0311: Chemistry of I	Drinking Water Treatment
Тур	Lecture
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dr. Klaus Johannsen
Language	DE
Cycle	WiSe
Content	The topic of this course is water chemistry with respect to drinking water treatment and water distribution
	Major topics are solubility of gases, carbonic acid system and calcium carbonate, blending, softening, redox processes, materials and legal requirements on drinking water treatment. Focus is put on generally accepted rules of technology (DVGW- and DIN- standards). Special emphasis is put on calculations using realistic analysis data (e.g. calculation of pH or calcium carbonate dissolution potential) in exercises. Students can get a feedback and gain extra points for exam by solving problems for homework. Knowledge of drinking water treatment processes is vital for this lecture. Therefore the most important processes are explained coordinated with the course " Water resources management" in the beginning of the semester.
Literature	 MHW (rev. by Crittenden, J. et al.): Water treatment principles and design. John Wiley & Sons, Hoboken, 2005. Stumm, W., Morgan, J.J.: Aquatic chemistry. John Wiley & Sons, New York, 1996. DVGW (Hrsg.): Wasseraufbereitung - Grundlagen und Verfahren. Oldenbourg Industrie Verlag, München, 2004. Jensen, J. N.: A Problem Solving Approach to Aquatic Chemistry. John Wiley & Sons, Inc., New York, 2003.

Course L0312: Chemistry of Drinking Water Treatment		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Dr. Klaus Johannsen	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0402: Water Resour	ce Management
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Mathias Ernst
Language	DE
Cycle	WiSe
Content	The lecture provides comprehensive knowledge on interaction of water ressource management and drinking water supply. Content
	overview: • Current situation of global water resources • User and Stakeholder conflicts • Wasserressourcenmanagement in urbane Gebieten • Rechtliche Aspekte, Organisationsformen Trinkwasserversorgungsunternehmen. • Ökobilanzierung, Benchmarking in der Wasserversorgung
Literature	 Aktuelle UN World Water Development Reports Branchenbild der deutschen Wasserwirtschaft, VKU (2011) Aktuelle Artikel wissenschaftlicher Zeitschriften Ppt der Vorlesung

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Course L0403: Water Resource Management		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Mathias Ernst	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M1505: Adap	tation to Climat	te Change in Hyd	raulic Engineer	ing (AKWAS)		
Courses						
Title			Туј)	Hrs/wk	СР
Adaptation to climate change in hy	draulic engineering (L22	91)	Proj	ect-/problem-based Learning	4	6
Module Responsible	Prof. Peter Fröhle					
Admission Requirements	None					
Recommended Previous Knowledge	 Hydrology, Hyd Hydromechanio Fundamentals Hydrological Sy 	draulic Engineering c, Hydraulics of Coastal Engineering, C ystems	ioastal- and Flood Prot	ection		
Educational Objectives	After taking part succ	essfully, students have re	eached the following le	arning results		
Professional Competence						
Knowledge Skills	 Climate protect Insights into cli Impacts of clim Fundamentals Consequences Measures for ct Assessment, pr Fundamentals Critical thinking Creative thinking Practical thinking Consideration of 	tion and climate adaptati imate change and its regi nate change on the compo of analysis of climate dat. of the impact of the clima limate adaptation rioritization and communi of the analysis of hydrom g: analysis of processes a ng: development of adapt ing: inclusion of restricti of complex tasks	on ional characteristics - f onents of the regional a ate change ication of adaptation m reteorological and hydr nd relations, assessme tation strategies and a ions, application of ca	undamentals, climate mode hydrological cycle neasures rological data ent of needs for action daptation measures alculation approaches, met	lling / climate	models al models, plannir
Social Competence						
Social Competence	Working in hetWorking with dSelf reflection	erogenous groups lifferent scientific / non-sc	cientific disciplines			
Autonomy	 Application original 	ented use of knowledge a	ind skills			
	Autonomous w	ork on complex tasks				
Workload in Hours	Independent Study Ti	me 124, Study Time in Le	ecture 56			
Credit points	6					
Course achievement	None					
Examination	Written elaboration					
Examination duration and	Preparation of a writte	en report and a presentat	tion of a complex task.			
scale						
Assignment for the	Civil Engineering: Spe	ecialisation Coastal Engine	eering: Elective Compu	ilsory		
Following Curricula	Civil Engineering: Spe	ecialisation Geotechnical E	Engineering: Elective C	ompulsory		
	Civil Engineering: Spe	ecialisation Structural Eng	ineering: Elective Com	ipuisory		
	Water and Environme	ectatisation water and Tra	inc: Elective Compuls	Compulsory		
	Water and Environme	ental Engineering: Special	isation Environment [,] F	lective Compulsory		
	Water and Environme	ental Engineering: Special	isation Water [,] Flective	Compulsory		

Course L2291: Adaptation to	climate change in hydraulic engineering
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe
Content	 Climate protection and climate adaptation Findings on climate change and its regional characteristics: fundamentals of climate change, climate modelling / climate models Impacts of climate change on the components of the regional hydrological cycle(climate science view) Fundamentals of the analysis of climate data Concequences of the impacts of climate change (ingenieering science view) Measures for climate change adaptation Assessment, prioritization and communication of measures Fundamentals of analysis of hydrometeorological and hydrological data
Literature	Bereitgestellte eLearning Plattform

Module M1725: Scien	tific Working in Computational Engin	eering		
Courses				
Title		Тур	Hrs/wk	СР
Scientific Working in Computationa	l Engineering (L2764)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None			
Recommended Previous	Basic knowledge in scientific writing. String interest in	topics related to computing in civil engine	ering.	
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Khowledge	course instructors and in collaboration with each other, the students will also learn to understand the complex process of scientific thinking, being able to accurately plan, implement and analyze scientific projects, such as prospective master theses. Since scientific writing is of particular importance in this course, a scientific paper will be developed, which is a prerequisite for the final examination. The paper will be written based on a project to be conducted within this course. Project meetings in small groups, presentations, and critical discussions of scientific publications are further key activities.			
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	66		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	10 pages of work with 15-minute oral presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Water and Traffic: Ele	ective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Enginee	ering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering:	Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineerin	g: Elective Compulsory		

Course L2764: Scientific Wo	rking in Computational Engineering
Тур	Project-/problem-based Learning
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Kay Smarsly
Language	EN
Cycle	WiSe/SoSe
Content	In the course, a scientific problem of practical relevance will first be defined, taking into account the interests of the students participating in the course. The scientific problem will then systematically be solved within the framework of a comprehensive project. The principles of scientific working will be taught based on the scientific problem defined previously. As an integral part of scientific working, fundamentals of scientific writing will be presented and applied to a scientific paper to be written during the course. Topics related to scientific writing include structuring in scientific writing (structuring the abstract, the introduction, the main part, the summary and conclusions, and the acknowledgments and references) and recommendations on effective scientific writing (principles of composition, use of English in scientific writing, useful tips, creating figures, writing in mathematics,
Literature	referencing, and formal email correspondence). A final paper and a final presentation will be assembled by the students.

Module M1721: Wate	and Environment: Theory and Applic	ation		
Courses				
Title		Тур	Hrs/wk	СР
Water and Environment: Applicatio	and Field Work (L2754)	Project-/problem-based Learning	3	4
Water and Environment: Theory (L	753)	Lecture	1	2
Module Responsible	Prof. Nima Shokri			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached t	he following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	5		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Report (about 5-10 pages) and Presentation (about 15	min)		
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: E	lective Compulsory		
Following Curricula	Civil Engineering: Specialisation Water and Traffic: Elec	tive Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: E	lective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elec	tive Compulsory		
	Environmental Engineering: Specialisation Water: Elect	ive Compulsory		
	Environmental Engineering: Specialisation Water: Elect	ive Compulsory		
	Water and Environmental Engineering: Specialisation C	ities: Elective Compulsory		
	Water and Environmental Engineering: Specialisation C	ities: Elective Compulsory		
	Water and Environmental Engineering: Specialisation E	nvironment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation E	nvironment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation V	Vater: Elective Compulsory		
	Water and Environmental Engineering: Specialisation V	Vater: Elective Compulsory		

Course L2754: Water and Environment: Application and Field Work		
Тур	Project-/problem-based Learning	
Hrs/wk	3	
СР	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Anna Luisa Hemshorn de Sánchez, Dr. Salome Shokri-Kuehni	
Language	EN	
Cycle	SoSe	
Content		
Literature		

Course L2753: Water and Environment: Theory	
Тур	Lecture
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Nima Shokri
Language	EN
Cycle	SoSe
Content	
Literature	

Module M1724: Smar	t Monitoring			
Courses				
Title		Тур	Hrs/wk	СР
Smart Monitoring (L2762)		Integrated Lecture	2	2
Smart Monitoring (L2763)		Recitation Section (small)	2	4
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None			
Recommended Previous	Basic knowledge or interest in object-oriented modeling, prog	ramming, and sensor techno	logies are helpfu	I. Interest in moderr
Knowledge	research and teaching areas, such as Internet of Things, Indu	stry 4.0 and cyber-physical s	ystems, as well a	is the will to deepen
	skills of scientific working, are required. Basic knowledge in scie	entific writing and good Englis	h skills.	
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	The students will become familiar with the principles and pr	actices of smart monitoring.	The students w	ill be able to desigr
	decentralized smart systems to be applied for continuous	(remote) monitoring of syste	ems in the built	and in the natura
	environment. In addition, the students will learn to design and	to implement intelligent sens	or systems using	state-of-the-art data
	analysis techniques, modern software design concepts, and em	bedded computing methodolo	ogies. Besides lec	tures, project work is
	also part of this module. In small groups, the students will	ll design smart monitoring s	systems that inte	egrate a number of
	"intelligent" sensors to be implemented by the students. S	pecific focus will be put on	the application	of machine learning
	techniques. The smart monitoring systems will be mounted on	real-world (built or natural) s	systems, such as	bridges or slopes, or
	on scaled lab structures for validation purposes. The outcome	of every group will be docun	nented in a paper	r. All students of this
	module will "automatically" participate with their smart moni	itoring system in the annual	"Smart Monitorir	ng" competition. The
	written papers and oral examinations form the final grades. The	e module will be taught in Eng	lish. Limited enro	llment.
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	10 pages of work with 15-minute oral presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Water and Traffic: Elective Com	npulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elec	tive Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective C	Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Elective	e Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective C	Compulsory		
	Civil Engineering: Specialisation Geotechnical Engineering: Elec	tive Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Elective	e Compulsory		
	Civil Engineering: Specialisation water and Traffic: Elective Con	npulsory		
	Environmental Engineering: Specialisation Waste and Energy: E	liective Compulsory		
	Environmental Engineering: Specialisation Biotechnology: Electro			
	Environmental Engineering: Specialisation Water. Elective Com	Justivo Compulson		
	Environmental Engineering: Specialisation Waste and Energy: E	ive Compulsory		
	Environmental Engineering: Specialisation Water: Elective Com	pulsory		
	Water and Environmental Engineering: Specialisation Viter: Elective Com	ctive Compulsory		
	Water and Environmental Engineering: Specialisation Cities: Ele	ctive Compulsorv		
	Water and Environmental Engineering: Specialisation Environmental	ent: Elective Compulsorv		
	Water and Environmental Engineering: Specialisation Environmental	ent: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Water: Ele	ective Compulsory		
	Water and Environmental Engineering: Specialisation Water: Ele	ective Compulsory		

Course L2762: Smart Monito	ring
Тур	Integrated Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Kay Smarsly
Language	EN
Cycle	WiSe/SoSe
Content	In this course, principles of smart monitoring will be taught, focusing on modern concepts of data acquisition, data storage, and data analysis. Also, fundamentals of intelligent sensors and embedded computing will be illuminated. Autonomous software and decentralized data processing are further crucial parts of the course, including concepts of the Internet of Things, Industry 4.0 and cyber-physical systems. Furthermore, measuring principles, data acquisition systems, data management and data analysis algorithms will be discussed. Besides the theoretical background, numerous practical examples will be shown to demonstrate how smart monitoring may advantageously be used for assessing the condition of systems in the built or natural environment.
Literature	

Course L2763: Smart Monito	ring
Тур	Recitation Section (small)
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Kay Smarsly
Language	EN
Cycle	WiSe/SoSe
Content	The contents of the exercises are based on the lecture contents. In addition to the exercises, project work will be conducted, which will consume the majority of the workload. As part of the project work, students will design smart monitoring systems that will be tested in the laboratory or in the field. As mentioned in the module description, the students will participate in the "Smart Monitoring" competition, hosted annually by the Institute of Digital and Autonomous Construction. Students are encouraged to contribute their own ideas. The tools required to implement the smart monitoring systems will be taught in the group exercises as well as through external sources, such as video tutorials and literature.
Literature	

Specialization Geotechnical Engineering

Module M0699: Geotechnics III Courses СР Title Тур Hrs/wk Numerical Methods in Geotechnics (L0375) Lecture 3 3 2 2 Advanced Foundation Engineering (L0497) Lecture Advanced Foundation Engineering (L0498) Recitation Section (large) 1 1 Module Responsible Prof. Jürgen Grabe Admission Requirements None **Recommended Previous** Knowledge Educational Objectives After taking part successfully, students have reached the following learning results **Professional Competence** Knowledge Skills Personal Competence Social Competence Autonomy Workload in Hours Independent Study Time 96, Study Time in Lecture 84 **Credit points** 6 Compulsory Bonus Form Description **Course achievement** Yes None Subject theoretical and practical work Examination Written exam Examination duration and 120 min scale Assignment for the Civil Engineering: Specialisation Structural Engineering: Compulsory **Following Curricula** Civil Engineering: Specialisation Geotechnical Engineering: Compulsory Civil Engineering: Specialisation Coastal Engineering: Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory

Course L0375: Numerical Methods in Geotechnics		
Тур	Lecture	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Dr. Hans Mathäus Stanford	
Language	DE	
Cycle	WiSe	
Content	Topics:	
	 numerical simulations numerical algorithms finite element method application of finite element method in geomechanics constitutive models for soils contact models for soil structure interaction selected applications 	
Literature	 Wriggers P. (2001): Nichtlineare Finite-Elemente-Methoden, Springer Verlag, Berlin Bathe Klaus-Jürgen (2002): Finite-Elemente-Methoden. Springer Verlag, Berlin 	

Course L0497: Advanced Foundation Engineering			
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Jürgen Grabe		
Language	DE		
Cycle	WiSe		
Content	 Vertical drains Piles Ground improvement (Deep Compaction, Soil mixing) Vibration driving Jet grouting Slurry wall Deep excavation 		
Literature	 EAK (2002): Empfehlungen für Küstenschutzbauwerke EAU (2004): Empfehlungen des Arbeitsausschusses Uferbauwerke EAB (1988): Empfehlungen des Arbeitskreises Baugruben Grundbau-Taschenbuch, Teil 1-3, (1997), Ernst & Sohn Verlag 		

Course L0498: Advanced Foundation Engineering		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Jürgen Grabe	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0858: Coast	al Hydraulic Engineering I			
Courses				
Title		Тур	Hrs/wk	СР
Basics of Coastal Engineering (L08)	7)	Lecture	3	4
Basics of Coastal Engineering (L14)	3)	Project-/problem-based Learning	1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Basics of hydraulic engineering, hydrology and hydrom	echanics		
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	The students are able to define and explain the basic c	oncepts of coastal engineering and port e	ngineering. Tl	ney are able to apply
	the concepts to selected practical problems of coastal engineering. Students can define and determine the basics for design and			
	dimensioning of coastal engineering constructions.			
Skille	The students are canable to apply basis design approach	has to selected and pro defined design to	ske in coasta	Longinooring
SKIIIS	The students are capable to apply basic design approac	hes to selected and pre-defined design ta		r engineering.
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge	e in applied problems such as the desig	n of coastal p	protection structures
	Additionaly, they will be able to work in team with engine	neers of other disciplines, for instance des	signing of coas	stal breakwaters.
Autonomy	The students will be able to independently extend their	knowledge and applyit to new problems.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 2 hours. The examination is 2 hours.	nination includes tasks with respect to	the general ι	Inderstanding of the
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Structural Engineering	Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineer	ng: Compulsory		
-	Civil Engineering: Specialisation Coastal Engineering: C	ompulsory		
	International Management and Engineering: Specialisat	ion II. Civil Engineering: Elective Compuls	ory	

Typ Lecture Hrs/wk 3 CP 4					
Hrs/wk 3 CP 4					
CP 4					
Workload in Hours Independent Study Time 78, Study Time in Lecture 42					
Lecturer Prof. Peter Fröhle					
Language DE					
Cycle WiSe					
Content					
Basics of planning and design Water levels					
Planning and Design in Coastal Engineering					
 Functional and constructional design 	 Functional and constructional design 				
 Determination of design parameters 	Determination of design parameters				
 Design-approaches 	Design-approaches				
■ Filter					
 Rubble mound constructions 					
■ Piles					
 Vertical constructions 					
Literature Coastal Engineering Manual, CEM					
Vorlesungsumdruck					

Course L1413: Basics of Coastal Engineering		
Тур	Project-/problem-based Learning	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Peter Fröhle	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0964: Unde	rground Constructions			
Courses				
Title		Тур	Hrs/wk	СР
Applied Tunnel Constructions (L240)7)	Lecture	2	3
Introduction to tunnel construction	(L0707)	Lecture	1	2
Introduction to tunnel construction	(L1811)	Recitation Section (large)	1	1
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous	Modules from Bachelor studies Civil and enviror	nmental engineering:		
Knowledge	Geotechnics I-II			
	Geolectinics Stool Structures LII			
Educational Objectives	After taking part successfully, students have re-	ached the following learning results		
Professional Competence				
Knowledge	Knowledge of different tunnel construction type	es as well as special methods and techniq	les of subsoil const	ruction. The students
	get deeper knowledge of steel and ground engi	neering as well as constructions knowledge	e concerning quay w	alls. Futhermore, the
	students get all the neccessary knowledge to	design singular construction elements for	sheet pile walls ar	nd they know how to
	choose the right construction elements depend	ing on the influencing conditions.		
Skills	Basic knowledge of tunnel design as well as p	practical skills in structural tunnel analysis	. Furthermore, the	students are able to
	dimension sheet pile wall construction regard	ling all constrution elements, to choose	he suitable constru	uction elements with
	respect to the influencing conditions, to design all kinds of sheet pile walls (wave sheet pile walls and combined sheet pile walls)			
	and to dimension all construction elements and	connections.		
Personal Competence				
Social Competence	Capacity for teamwork concerning project management and design of tunnels.			
Autonomy	Promotion of independent and creative work flo	w in the framework of a design exercise.		
Workload in Hours	Independent Study Time 124, Study Time in Lee	cture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 minutes			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engi	neering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical E	ngineering: Compulsory		
	Civil Engineering: Specialisation Coastal Engine	ering: Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory			
	International Management and Engineering: Sp	ecialisation II. Civil Engineering: Elective Co	mpulsory	

Course L2407: Applied Tunnel Constructions		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Jürgen Grabe, Tim Babendererde	
Language	DE	
Cycle	WiSe	
Content		
Literature		

Course L0707: Introduction t	to tunnel construction			
Тур	Lecture			
Hrs/wk	1			
СР				
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14			
Lecturer	Dr. Marius Milatz			
Language	DE			
Cycle	WiSe			
Content	 Definitions Historical development in tunneling Geology for tunneling Hard rock tunneling (construction composite and machines) Tunnelung in temporarly stable soil with conventional construction methods Tunneling in soft soils (form of supports, shield types, compressed air application) Pipe jacking Tunnel Lining, tunnel supporting structures Calculation approaches for supporting structures in shield-driven tunnels Surveying for tunneling Safety requirements Construction Contract Literature and sources 			
Literature	Vorlesung/Übung s. www.tu-harburg.de/gbt			

Course L1811: Introduction to tunnel construction		
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Marius Milatz	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0511: Electr	icity Generation from Wind and H	lydro Power			
Courses					
Title		Тур	Hrs/wk	СР	
Sustainability Management (L0007)	Lecture	2	1	
Hydro Power Use (L0013)		Lecture	1	1	
Wind Turbine Plants (L0011)		Lecture	2	3	
Wind Energy Use - Focus Offshore	L0012)	Lecture	1	1	
Module Responsible	Dr. Isabel Höfer				
Admission Requirements	None				
Recommended Previous	Module: Technical Thermodynamics I,				
Knowledge	Module: Technical Thermodynamics II,				
	Module: Fundamentals of Fluid Mechanics				
Educational Objectives	After taking part successfully, students have read	thed the following learning results			
Professional Competence					
Knowledge	By ending this module students can explain in	detail knowledge of wind turbines wit	th a particular focus of	f wind energy use in	
	offshore conditions and can critical comment the	ese aspects in consideration of current	developments. Furthe	rmore, they are able	
	to describe fundamentally the use of water powe	er to generate electricity. The students	reproduce and explain	the basic procedure	
	in the implementation of renewable energy proje	cts in countries outside Europe.	-p		
	Through active discussions of various topics wi	thin the seminar of the module, stuc	ents improve their un	derstanding and the	
	application of the theoretical background and are	e thus able to transfer what they have	earned in practice.		
Skills	Students are able to apply the acquired theore	etical foundations on exemplary water	r or wind power syster	ns and evaluate and	
	assess technically the resulting relationships in	the context of dimensioning and open	ation of these energy s	systems. They can in	
	compare critically the special procedure for the i	mplementation of renewable energy p	rojects in countries out	side Europe with the	
	in principle applied approach in Europe and can a	apply this procedure on exemplary the	oretical projects.	·	
Personal Competence					
Social Competence	Students can discuss scientific tasks subjet-spec	ificly and multidisciplinary within a ser	ninar.		
Autonomy	Students can independently exploit sources in t	the context of the emphasis of the le	cture material to clear	the contents of the	
	lecture and to acquire the particular knowledge a	bout the subject area.			
Workload in Hours	Independent Study Time 06, Study Time in Lectu	ro 94			
Credit points	6	10 04			
Course achievement	None				
Examination	Written exam				
Examination	2.5 hours written ever 4. Prencentation in sustai	nability management			
Examination duration and	2.5 hours whitten exam + Prensentation in sustai	hability management			
Assignment for the	Civil Engineering: Englishing Structural Engine	aring Flastive Compulsory			
Eollowing Curricula	Civil Engineering: Specialisation Structural Engine	gineering: Elective Compulsory			
Following curricula	Civil Engineering: Specialisation Geotechnical Engineering	ring: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory				
	International Management and Engineering: Specials	cialisation II. Renewable Energy: Elective Col	ve Compulsory		
	International Management and Engineering: Specialisation II. Renewable Energy: Elective Compulsory International Management and Engineering: Specialisation II. Energy and Environmental Engineering: Elective Compulsory Product Development, Materials and Production: Specialisation Product Development, Elective Compulsory				
	Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory				
	Product Development, Materials and Production: Specialisation Production: Elective Compulsory				
	Renewable Energies: Core Qualification: Compulsory				
	Theoretical Mechanical Engineering: Technical Complementary Course: Flective Compulsory				
	Theoretical Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory				
	Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory				
	Water and Environmental Engineering: Specialisation Environment: Compulsory				
	Water and Environmental Engineering: Specialisation Cities: Elective Compulsory				

Course L0007: Sustainability Management		
Тур	Lecture	
Hrs/wk	2	
CP	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Dr. Anne Rödl	
Language	DE	
Cycle	WiSe	
Content	The lecture sustainability management provide an insight into the various aspects and dimensions of sustainability. This content of the course is based on the foundations of environmental assessment; therefore the previous attendance of the lecture environmental assessment is recommended. Various valuation approaches for assessing environmental, economic and social aspects are presented. Their application and use for a sustainability management's discussion is explained by means of short technology examples and is later comprehensively presented through case examples. • Introduction to the topic of sustainability • Dimensions of sustainability: • ecology • economics • social • Transition from the environmental assessment for sustainability management • Case Studies • Excursion	
	Objective: The aim of the course is to learn methods for the assessment of sustainability aspects and apply for sustainability management.	
Literature	Engelfried, J. (2011) Nachhaltiges Umweltmanagement. München: Oldenbourg Verlag. 2. Auflage	
	Corsten H., Roth S. (Hrsg.) (2011) Nachhaltigkeit - Unternehmerisches Handeln in globaler Verantwortung. Wiesbaden: Gabler Verlag.	

Course L0013: Hydro Power Use		
Тур	Lecture	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Stefan Achleitner, Hugo Götsch	
Language	DE	
Cycle	SoSe	
Content	 Introduction, importance of water power in the national and global context Physical basics: Bernoulli's equation, usable height of fall, hydrological measures, loss mechanisms, efficiencies Classification of Hydropower: Flow and Storage hydropower, low and high pressure systems Construction of hydroelectric power plants: description of the individual components and their technical system interaction Structural engineering components; representation of dams, weirs, dams, power houses, computer systems, etc. Energy Technical Components: Illustration of the different types of hydraulic machinery, generators and grid connection Hydropower and the Environment Examples from practice 	
Literature	 Schröder, W.; Euler, G.; Schneider, K.: Grundlagen des Wasserbaus; Werner, Düsseldorf, 1999, 4. Auflage Quaschning, V.: Regenerative Energiesysteme: Technologie - Berechnung - Simulation; Carl Hanser, München, 2011, 7. Auflage Giesecke, J.; Heimerl, S.; Mosony, E.: Wasserkraftanlagen - Planung, Bau und Betrieb; Springer, Berlin, Heidelberg, 2009, 5. Auflage von König, F.; Jehle, C.: Bau von Wasserkraftanlagen - Praxisbezogene Planungsunterlagen; C. F. Müller, Heidelberg, 2005, 4. Auflage Strobl, T.; Zunic, F.: Wasserbau: Aktuelle Grundlagen - Neue Entwicklungen; Springer, Berlin, Heidelberg, 2006 	

Course L0011: Wind Turbine Plants		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Dr. Rudolf Zellermann, Dr. Jochen Oexmann	
Language	DE	
Cycle	SoSe	
Content	 Historical development Wind: origins, geographic and temporal distribution, locations Power coefficient, rotor thrust Aerodynamics of the rotor Operating performance Power limitation, partial load, pitch and stall control Plant selection, yield prediction, economy Excursion 	
Literature	Gasch, R., Windkraftanlagen, 4. Auflage, Teubner-Verlag, 2005	

Course L0012: Wind Energy Use - Focus Offshore				
Тур	Lecture			
Hrs/wk	1			
CP	1			
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14			
Lecturer	Prof. Martin Skiba			
Language	DE			
Cycle	SoSe			
Content	 Introduction, importance of offshore wind power generation, Specific requirements for offshore engineering Physical fundamentals for utilization of wind energy Design and operation of offshore wind turbines, presentation of different concepts of offshore wind turbines, representation of the individual system components and their system-technical relationships Foundation engineering, offshore site investigation, presentation of different concepts of offshore foundation structures, planning and fabrication of foundation structures Electrical infrastructure of an offshore wind farm, Inner Park cabling, offshore substation, grid connection Installation of offshore wind farms, installation techniques and auxiliary devices, construction logistics Development and planning of offshore wind farms Operation and optimization of offshore wind farms Day excursion 			
Literature	 Gasch, R.; Twele, J.: Windkraftanlagen - Grundlagen, Entwurf, Planung und Betrieb; Vieweg + Teubner, Stuttgart, 2007, 7. Auflage Molly, J. P.: Windenergie - Theorie, Anwendung, Messung; C. F. Müller, Heidel-berg, 1997, 3. Auflage Hau, E.: Windkraftanalagen; Springer, Berlin, Heidelberg, 2008, 4.Auflage Heier, S.: Windkraftanlagen - Systemauslegung, Integration und Regelung; Vieweg + Teubner, Stuttgart, 2009, 5. Auflage Jarass, L.; Obermair, G.M.; Voigt, W.: Windenergie: Zuverlässige Integration in die Energieversorgung; Springer, Berlin, Heidelberg, 2009, 2. Auflage 			
Module M1351: Const	ruction Processes			
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Courses				
Title		Тур	Hrs/wk	СР
Digital Building (L1908)		Lecture	2	2
Lean Construction (L1910)		Lecture	2	2
System Dynamics (L1909)		Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal I	Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotech	nical Engineering: Elective Compulsory		
-	Civil Engineering: Specialisation Structura	al Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water ar	nd Traffic: Elective Compulsory		

Course L1908: Digital Building	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Katja Maaser
Language	DE
Cycle	SoSe
Content	
Literature	

Course L1910: Lean Construction	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Theo Herzog
Language	DE
Cycle	SoSe
Content	
Literature	

Course L1909: System Dynamics	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Markus Salge
Language	DE
Cycle	SoSe
Content	
Literature	

Module M0593: Building Materials and Building Preservation

Courses			
Title	Тур	Hrs/wk	СР
Repair of Structures (L0255)	Lecture	1	1
Mineral Building Materials (L0253)	Lecture	2	2
Technology of mineral Building Mat	erials (L0256) Project-/problem-based Learni	ng 1	2
Transport Processes in Building Ma	terials and Damage Processes (L0254) Lecture	1	1
Module Responsible	Prof. Frank Schmidt-Döhl		
Admission Requirements	None		
Recommended Previous	Basic knowledge about building materials, building physics and building chemistry, for e	ample by the r	nodules Principles of
Knowledge	Building Materials and Building Physics and Building Materials and Building Chemistry.		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	The students are able to describe the components of mineral building materials and their fun	ction in detail ar	d to use them for the
	manufacture of special mineral building materials. They are able to show the characteristics	f mineral buildir	g materials. They are
	able to describe the manufacture, properties and fields of application of special mortars and	special concrete	s and the correlations
	of their material parameters. They are able to show the principles of anchor technology and o	esign.	
Skills	The students are able to perform an optimization of granulometry of a mineral building mate	rial. They are ab	le to design a special
	mineral mortar and to manufacture this mortar. The students are able to manufacture post	installed rebar c	onnections. They are
	able to recognize damages, to assess possible causes, to use the fundamentals of construct	ion preservation	and to select repair
	and strengthening measures.		
Personal Competence			
Social Competence	The students are able to develop in small grous the mixture of a special mortar. They prese	t their results to	the lecturer and the
Social competence	other students. In a critical discussion they defend and adjust their results. The students	re able to man	ufacture their special
	huilding material on the basis of this feedback		
	building indicinal on the basis of this recabacit.		
Autonomy	The students are able to responsibly use the resources of materials and lab equipment for t	neir project and	to investigate and to
	get missing components.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70		
Credit neinte			
Credit points	0 Computery Bonus Form Description		
Course achievement	Ves 20% Subject theoretical and		
	practical work		
Examination	Written evam		
Examination duration and	120 min		
crala	120 11111		
Assignment for the	Civil Engineering: Specialisation Geotechnical Engineering: Compulsory		
Eollowing Curricula	Civil Engineering, Specialisation Geotechnical Engineering, Compulsory		
Following curricula	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory		
	Civil Engineering, Specialisation Structural Engineering: Elective Compulsory		
	civil Engineering: Specialisation water and Tramic: Elective Compulsory		

Course L0255: Repair of Structures	
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Frank Schmidt-Döhl
Language	DE
Cycle	SoSe
Content	Maintenance of structures, repair and strengthening, subsequent waterproofing of structures
Literature	BetonMarketing Deutschland (Hrsg.): Stahlbetonoberflächen - schützen, erhalten, instandsetzen

Course L0253: Mineral Build	ing Materials
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Frank Schmidt-Döhl
Language	DE
Cycle	SoSe
Content	Components of mineral building materials and their function, binding materials, concrete and mortar, special mortars, special
	concretes
Literature	Taylor, H.F.W.: Cement Chemistry
	Springenschmid, R.: Betontechnologie für die Praxis

Course L0256: Technology o	Course L0256: Technology of mineral Building Materials	
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Frank Schmidt-Döhl	
Language	DE	
Cycle	SoSe	
Content	Design and production of a special mineral building material	
Literature	Taylor, H.F.W.: Cement Chemistry	
	Springenschmid, R.: Betontechnologie für die Praxis	

Course L0254: Transport Processes in Building Materials and Damage Processes	
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Frank Schmidt-Döhl
Language	DE
Cycle	SoSe
Content	Transport Processes in Building Materials and Damage Processes
Literature	Blaich, J.: Bauschäden, Analyse und Vermeidung

Module M0723: Desig	n of Prestressed Structures	and Concrete Bridges		
Courses				
Title		Тур	Hrs/wk	СР
Design of Prestressed Structures a	nd Concreet Bridges (L0603)	Lecture	3	4
Design of Prestressed Structures a	nd Concreet Bridges (L0604)	Recitation Section (large)	2	2
Module Responsible	Prof. Günter Rombach			
Admission Requirements	None			
Recommended Previous	Detailed knowledge on the design of cond	crete structures.		
Knowledge	Modules: Reinforced Concrete Structures	I+II, Structural Analysis I+II, Mechanics I+II, Con	crete Structures	
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
Knowledge	The students know the main bridge type	es, their applications and the various loads. The	, can explain the b	asic design methods
	They can explain the design of a prestres	sed bridge.		
Skills	The students are able to design reinforce	d or prestressed concrete bridges.		
Personal Competence				
Social Competence	The students can design in teamwork a re	eal concrete bridge.		
Autonomy	The students are able to design a prestre	ssed concrete bridge and discuss the problems a	nd results with othe	er students.
Workload in Hours	Independent Study Time 110, Study Time	e in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 minutes			
scale				
Assignment for the	Civil Engineering: Specialisation Structure	al Engineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechr	nical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal E	Engineering: Elective Compulsory		
	International Management and Engineering	ng: Specialisation II. Civil Engineering: Elective Co	ompulsory	

Course L0603: Design of Prestressed Structures and Concreet Bridges		
Тур	Lecture	
Hrs/wk	3	
CP	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Günter Rombach	
Language	DE	
Cycle	SoSe	
Content	prestressed structures	
	 basis of prestressed structures, field of application differences between reinforced and prestressed concrete structures history of prestressing construction materials: concrete, tendons, ducts, anchorage systems construction: prestressing methods prestressing forces and member forces (friction, elongation) tendon layout time dependant prestressing losses design of prestressed structures design of anchorage region non-bonded prestressing prestressed flat slabs 	
	Concrete bridges history of bridges design of bridges loads on bridges loads on bridges member forces for slab, T-beam, hollow box, frame and arch bridges precast bridges - precast segmental bridges bearings abutments, columns construction methods damages - checking of bridges 	
Literature	 Vorlesungsumdruckim STUDiP Rombach, G. (2003): Spannbetonbau. Ernst & Sohn, Berlin Wicke, M. (2002): Anwendung des Spannbetons. Betonkalender 2002, Teil II, S. 113-180, Verlag Ernst & Sohn, Berlin Leonhardt, F. (1980): Vorlesungen über Massivbau. Teil 5: Spannbeton. Berlin Mehlhorn, G. (2007): Handbuch Brücken, Springer Verlag Schäfer, H.; Kaufeld, K. (1997): Massivbrücken. Betonkalender Teil II, S. 443ff, Ernst & Sohn, Berlin Menn, Ch. (1986): Stahlbetonbrücken. Springer Verlag, Wien 	

Course L0604: Design of Prestressed Structures and Concreet Bridges	
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0756: Soil M	lechanics and -	Dynamics				
Courses						
Title				Тур	Hrs/wk	CP
Soil Mechanics - Selected Topics (L0374)			Lecture	2	2	
Soil Dynamics (L0452)				Lecture	3	2
Experimental Researches in Geotec	chnics (L0706)			Practical Course	1	2
Module Responsible	Prof. Jürgen Grabe					
Admission Requirements	None					
Recommended Previous	modules: Mathematic	s I-III, Mechanics I-II, Geo	otechnics I			
Knowledge	courses: Soil laborato	ry course, (Applied struc	tural dynamics)			
Educational Objectives	After taking part succ	essfully, students have r	eached the following	ng learning results		
Professional Competence						
Knowledge	After the successful c	ompletion of the module	the students shou	ld be able to:		
	 to derive and t 	o apply the basic equation	on of a simple mass	s oscillator.		
	 to understand 	the wave propagation in	the soil under dyna	amic excitation and to	detect the relevant par	ameters,
	 to know the es 	sential laboratory and fie	eld tests to determi	ne soil dynamic charac	teristics and to evaluat	te them,
	 to design mach 	nine foundations to dyna	mic load,			
	 to measure she 	ocks to perform vibration	forecast,			
	 to evaluate sho 	ocks in term to their effe	ct on people and b	uildings,		
	to evaluate possibilities of isolation,					
	• to understand mechanisms that cause earthquakes and evaluate earthquake in term of their magnitude and intensity,					
	 to know methods to determine axial pile capacity, integrity and the dynamic bedding modulus, 					
	• to know the mechanisms that lead to a deformation accumulation due to cyclic loading and to estimate these deformations					
	mathematically,					
	 to distinguish the area of application of the method of elastodynamics and plastodynamics, 					
	 to detect the undrained shear strength as a function of a number of state variables, 					
	 to capture the 	 to capture the viscous behaviour of cohesive soils and to consider the effects of creep and rate-dependent shear strength in 				
	calculations,					
	 to consider the impact of the partly saturated of a seepage and shear strength. 					
Skills						
Personal Competence						
Social Competence						
Autonomy						
Workload in Hours	Independent Study Ti	me 96, Study Time in Le	cture 84			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	Yes 15 %	Subject theoretical	and			
		practical work				
Examination	Written exam					
Examination duration and	150 min					
scale						
Assignment for the	Civil Engineering: Spe	cialisation Structural Eng	gineering: Elective	Compulsory		
Following Curricula	Civil Engineering: Spe	cialisation Geotechnical	Engineering: Comp	oulsory		
	Civil Engineering: Spe	cialisation Coastal Engin	eering: Elective Co	mpulsory		

Course L0374: Soil Mechanics - Selected Topics		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Hans Mathäus Stanford	
Language	DE	
Cycle	SoSe	
Content	selected topis:	
	- continuum mechanis	
	- constitutive modelling	
	- time and rate dependend material behavior of soils	
	- cyclic loading	
	- undrained conditions	
Literature	Kolymbas D. (2007): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. Springer Verlag	

Course L0452: Soil Dynamics	
Тур	Lecture
Hrs/wk	3
СР	2
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42
Lecturer	Alexander Chmelnizkij
Language	DE
Cycle	SoSe
Content	• mass-spring-damper systems,
	• wave propagation in soils,
	dynamic soil parameters,
	Determination of dynamic soil parameters,
	• machine foundations,
	• in-situ measurement of ground motion, ground motion prediction, evaluation of ground motion,
	• ground motion shielding,
	• introduction into earthquake engineering,
	• dynamic pile tests,
	• cyclic accumulation,
	• plastodynamics
Literature	 Das B.M.: Fundamentals of Soil Dynamics, Elsevier Empfehlungen des Arbeitskreises Baugrunddynamik. Hrsg. Deutsche Gesellschaft für Geotechnik (DGGT) Haupt W.: Bodendynamik. Vieweg und Teubner Meskouris K. und Hinzen KG.: Bauwerke und Erdbeben. Vieweg Verlag Studer J.A., Koller M.G. und Laue J.: Bodendynamik, Springer Verlag

Course L0706: Experimental	Researches in Geotechnics
Тур	Practical Course
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Dr. Marius Milatz
Language	DE
Cycle	SoSe
Content	The students are supposed to:
	 become acquainted with geotechnical model tests, field tests and laboratory tests as well as corresponding measurement techniques. These compromise amongst others inclinometer measurements and geophone measurements as well as high-grade laboratory tests on the stress-strain relationship of soil specimens, e. g. triaxial tests, simple shear tests and resonant column tests. gain insight into current soil mechanical research. plan, coordinate, perform and evaluate soil mechanical tests in a team. discuss, reflect, review and present the obtained results in a group. An important learning target is the introduction to scientific work for students who plan a scientific career, and for those who will work in practice with the responsibility to order corresponding tests and evaluate the results. The practical laboratory work is based on annualy changing problems, which are however related to the experience and results of the preceding year's course group.
Literature	- Grabe, J. (2004): Bodenmechanik und Grundbau, Band 3 der Veröffentlichungsreihe des Instituts für Geotechnik und Baubetrieb, Technische Universität Hamburg-Harburg.
	- Kolymbas, D. (2007): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. 2., korrigierte und ergänzte Auflage, Springer Verlag.
	 Normen zu geotechnischen Versuchsgeräten und Versuchsverfahren: DIN 18135:2012-04: Baugrund, Untersuchung von Bodenproben - Eindimensionaler Kompressionsversuch, Deutsches Institut für Normung, e. V.
	- DIN 18137-2:2011-04: Baugrund, Untersuchung von Bodenproben - Bestimmung der Scherfestigkeit - Teil 2: Triaxialversuch, Deutsches Institut für Normung e. V.

Module M0807: Bound	dary Element N	Methods				
Courses						
Title				Тур	Hrs/wk	CP
Boundary Element Methods (L0523	3)			Lecture	2	3
Boundary Element Methods (L0524	1)			Recitation Section (large)	2	3
Module Responsible	Prof. Otto von Estorf	f				
Admission Requirements	None					
Recommended Previous	Mechanics I (Statics,	Mechanics of Ma	aterials) and Mechanics	II (Hydrostatics, Kinematics, Dy	mamics)	
Knowledge	Mathematics I, II, III (Mathematics I, II, III (in particular differential equations)				
Educational Objectives	After taking part cur	cossfully, studen	ts have reached the fell	owing loorning results		
Brofessional Competence	Alter taking part suc	cessiully, studer		owing learning results		
Knowledge	The students nosses	s an in-denth k	owledge regarding the	derivation of the boundary el	ement method and	l are able to give an
Knowicage	overview of the theo	retical and meth	odical basis of the meth	ind		are able to give an
	overview of the theo		ould busis of the meth			
CI-ill-	The shudents are					
SKIIIS	The students are of	capable to han	ale engineering proble	ems by formulating suitable	boundary elemer	its, assembling the
	corresponding system	m maurices, and	solving the resulting sys	stem of equations.		
Personal Competence						
Social Competence	Students can work in	n small groups or	n specific problems to ar	rive at joint solutions.		
Autonomy	The students are ab	le to independer	ntly solve challenging o	omputational problems and de	welon own bounda	ry element routines
Autonomy	Problems can be ide	ntified and the re	esults are critically scrut	inized		ry element routilies.
Workload in Hours	Independent Study T	ime 124, Study	Time in Lecture 56			
Credit points	6	F	Description			
Course achievement	No 20 %	Midterm	Description	I		
Examination	Written exam	. naterin				
Examination duration and	90 min					
scale						
Assignment for the	Civil Engineering: Sp	ecialisation Stru	ctural Engineering: Elect	tive Compulsory		
Following Curricula	Civil Engineering: Sp	ecialisation Geol	echnical Engineering: El	lective Compulsory		
	Civil Engineering: Sp	ecialisation Coas	stal Engineering: Elective	e Compulsory		
	Energy Systems: Cor	re Qualification: I	Elective Compulsory			
	Mechanical Engineer	ring and Manage	ment: Specialisation Pro	duct Development and Product	ion: Elective Comp	ulsory
	Mechatronics: Specia	alisation System	Design: Elective Compu	lsory		
	Product Developmen	nt, Materials and	Production: Core Qualified	cation: Elective Compulsory		
	Technomathematics	: Specialisation I	II. Engineering Science:	Elective Compulsory		
	Technomathematics	: Specialisation I	II. Engineering Science:	Elective Compulsory		
	Theoretical Mechanic	cal Engineering:	Technical Complementa	ry Course: Elective Compulsory	/	
	Theoretical Mechanic	cal Engineering:	Specialisation Simulation	n Technology: Elective Compul	sory	

Course L0523: Boundary Element Methods				
Тур	Lecture			
Hrs/wk	2			
СР	3			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Lecturer	Prof. Otto von Estorff			
Language	EN			
Cycle	SoSe			
Content	- Boundary value problems			
	- Integral equations			
	- Fundamental Solutions			
	- Element formulations			
	- Numerical integration			
	- Solving systems of equations (statics, dynamics)			
	- Special BEM formulations			
	- Coupling of FEM and BEM			
	- Hands-on Sessions (programming of BE routines)			
	Applications			
	- Appleadore			
Literature	Gaul, L.; Fiedler, Ch. (1997): Methode der Randelemente in Statik und Dynamik. Vieweg, Braunschweig, Wiesbaden			
	Bathe, KJ. (2000): Finite-Elemente-Methoden. Springer Verlag, Berlin			

Course L0524: Boundary Eler	Course L0524: Boundary Element Methods		
Тур	Recitation Section (large)		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Otto von Estorff		
Language	EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M0827: Mode	ling in Water Management					
Courses						
Title Groundwater Modeling using Modfl Groundwater Modeling using Modfl	ow (L0543) ow (L0544)	Typ Lecture Recitation Section (small)	Hrs/wk 1 2	CP 1 2		
Modeling of Water Supply and Sew	er Network (L0875)	Project-/problem-based Learning	2	3		
Module Responsible	Dr. Klaus Johannsen					
Admission Requirements	None					
Recommended Previous Knowledge	 Groundwater groundwater hydraulics and transport of substances Pipe Systems Knowledge on urban water infrastructures, in particular drinking water systemsand urban drainage systems including special structures Hydraulics of drinking water supply systems and sewer systems Basic knowledge on water management 					
Educational Objectives	After taking part successfully, students have reache	ed the following learning results				
Professional Competence						
Knowledge	The students are able to describe the modelling of groundwater flow and transport as well as urban water infrastructures. They carry out systems analyses and can detect technical and conceptual weak points within the systems in case studies. Besides the are able to analyse interdependencies of hydraulic and toxic phenomena in soil and water.			astructures. They can studies. Besides they		
Skills	The students are able to construct and apply scient and can compare or assess different solutions for e able to use different software solutions (e.g. EPANE	ntific groundwater models indipendently. The xisting problems by application of selected so T, EPA-SWMM).	y can work o)ftware produ	n different scenarios ıcts. The students are		
Personal Competence						
Social Competence	Wird nicht vermittelt.					
Autonomy	Wird nicht vermittelt.					
Workload in Hours	Independent Study Time 110, Study Time in Lecture	e 70				
Credit points	6					
Course achievement	None					
Examination	Oral exam					
Examination duration and	20 min					
scale						
Assignment for the	Civil Engineering: Specialisation Structural Engineer	ing: Elective Compulsory				
Following Curricula	Civil Engineering: Specialisation Geotechnical Engin	eering: Elective Compulsory				
	Civil Engineering: Specialisation Coastal Engineerin	g: Elective Compulsory				
	Water and Environmental Engineering: Specialisation Water and Fraffic:					
	water and Environmental Engineering: Specialisation water: Compulsory					
	Water and Environmental Engineering: Specialisatio	an Environment: Elective Compulsory				
	water and Environmental Engineering: Specialisation	on Cities: Elective Compulsory				

Course L0543: Groundwater	Modeling using Modflow
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Sonja Götz
Language	DE/EN
Cycle	SoSe
Content	Introduction and application of the groundwater model MODFLOW (PMWIN); theoretical backround of the modell, students do work
	with the model PMWIN for practical case studies.
Literature	MODFLOW-Handbuch
	Chiang, Wen Hsien: PMWIN

Course L0544: Groundwater	Course L0544: Groundwater Modeling using Modflow			
Тур	Recitation Section (small)			
Hrs/wk	2			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Sonja Götz			
Language	DE/EN			
Cycle	SoSe			
Content	See interlocking course			
Literature	See interlocking course			

Course L0875: Modeling of Water Supply and Sewer Network			
Тур	Project-/problem-based Learning		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Dr. Klaus Johannsen, Weitere Mitarbeiter		
Language	DE		
Cycle	SoSe		
Content			
Literature	Mutschmann/Stimmelmayr: Taschenbuch der Wasserversorgung, 16. Auflage. Springer Vieweg - Verlag. Wiesbaden 2014.		

Module M0828: Urban	Environmental Management			
Courses				
Title	Тур		Hrs/wk	СР
Noise Protection (L1109)	Lecture		2	2
Urban Infrastructures (L0874)	Project-/problem-based Le	arning	2	4
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
Recommended Previous	Knowledge on Urban planning			
Knowledge	Knowledge on measures for climate protection			
	General knowledge of scientific writing/working			
	After taking part successfully, students have reached the following learning results			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Knowledge	Students can describe urban development corridors as well as current and future urban d	nviron	mental proble	ms. They are able t
Kilowieuge	explain the causes of environmental problems (like noise)	INVITORI		ins. They are able t
	Students can specify applications for various technical innovations and explain why these	contri	bute to the in	provement of urba
	life. They can, for example, derive and discuss measures for effective noise abatement.			
Skills	Students are able to develop specific solutions for correcting existing or future environment-related problems of urban			
	development. They can define a range of conceptual and technical solutions for environmental problems for different development			
	paths. To solve specific urban environmental problems they can select technical innova	tions a	nd integrate	them into the urba
Personal Competence	context.			
Social Competence	The students can work together in international groups			
boeiar competence				
Autonomy	Students are able to organize their work flow to prepare themselves for presentations a	nd cont	tributions to t	he discussions. The
	can acquire appropriate knowledge by making enquiries independently.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Written Report plus oral Presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory			
	Environmental Engineering: Core Qualification: Elective Compulsory		maulaam	
	Joint European Master in Environmental Studies - Cities and Sustainability: Core Qualificat	ion: Col	mpulsory	
	Notor and Environmental Engineering, Specialisation Intrastructure and Mobility: Elective C	ompuls	ory	
	water and Environmental Engineering: Specialisation Environment: Elective Compulsory			
	water and Environmental Engineering: Specialisation Cities: Compulsory			

Course L1109: Noise Protection		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Martin Jäschke	
Language	EN	
Cycle	SoSe	
Content		
Literature	1) Müller & Möser (2013): Handbook of Engineering Acoustics (also available in German)	
	2) WHO (1999): Guidelines for Community Noise	
	3) Environmental Noise Directive 2002/49/EG	
	4) ISO 9613-2 (1996): Acoustics, Attenuation of sound during propagation outdoors, Part 2: General method of calculation	

Course L0874: Urban Infrastructures	
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Dr. Dorothea Rechtenbach
Language	EN
Cycle	SoSe
Content	Problem Based Learning
	 Main topics are: Central vs. Decentral Wastewater Treatment. Compaction of Cities. Car Free Cities. Multifunctional Places in Cities. The Sustainability of Freight Transport in Cities.
Literature	Depends on chosen topic.

Module M0859: Coast	al Hydraulic Engineering II			
Courses				
Title		Тур	Hrs/wk	СР
Coastal- and Flood Protection (L080	(8)	Lecture	2	3
Coastal- and Flood Protection (L14)	5)	Project-/problem-based Learning	1	1
Maintennance and Defence of Floo	d Protection Structures (L1411)	Lecture	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Coastal Engineering I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follo	owing learning results		
Professional Competence				
Knowledge	The students have the capability to define and explain in de	tail the important aspects of erosi	on protection	and flood protection
	and are able to apply the aspects to practical coastal prot	ection problems. They are able to	design and	dimension importan
	coastal protection measures from the functional and from the	e constructional point of view.		
e			<i>c</i>	
Skills	The students are able to select design approaches for the	functional and constructional desig	gn of erosion	and flood protectio
	measures and apply these approaches to practical design tas	KS.		
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge in	applied problems such as the fun-	ctional and co	onstructive design o
	coastal and flood protection structures. Additionaly, they will	be able to work in team with engine	eers of other d	lisciplines.
Autonomy	The students will be able to independently extend their know	ledge and apply it to new problems		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 130 min. The examination includes tasks with respect to the general understanding of the			
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: El	ective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Comput	sory		

Course L0808: Coastal- and Flood Protection	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	SoSe
Content	Protection of sandy coasts
	Sediment transport
	Technical solution for the protection of sandy coasts
	Construction in direction of the coast
	Constructions perpendicular to the coast
	Other Concepst
	Calculation approaches and numerical models
	Flood Protection
	Classification of constructions / measures
	• Dikes
	• Dunes
	Foreland - constructions
	Flood-Protection Walls
	Drainage of the hinterland
Literature	Vorlesungsumdruck
	Coastal Engineering Manual CEM

Course L1415: Coastal- and Flood Protection	
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1411: Maintennance and Defence of Flood Protection Structures	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Olaf Müller
Language	DE
Cycle	SoSe
Content	 Dike protection Maintennance of flood protection measures
Literature	Vorlesungsumdruck

Module M0860: Harbo	our Engineering and Harbour Plannin	g		
Courses				
Title Harbour Engineering (L0809) Harbour Engineering (L1414)		Typ Lecture Project-/problem-based Learning	Hrs/wk 2 1	CP 2 2
Port Planning and Port Construction	n (L0378)	Lecture	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Basics of coastal engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	he following learning results		
Professional Competence				
Knowledge	The students are able to define in details and to choo	ose design approaches for the functional d	esign of a po	ort and apply them to
	design tasks. They can design the fundamental eleme	nts of a port.		
Skills	The students are able to select and apply appropriate	approaches for the functional design of po	ts.	
Personal Competence				
Social Competence	The students are able to deploy their gained knowled	lge in applied problems such as the funct	ional design	of ports. Additionaly,
	they will be able to work in team with engineers of oth	er disciplines.		
Autonomy	The students will be able to independently extend the	r knowledge and apply it to new problems.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 7	Independent Study Time 110, Study Time in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 150 min. The ex	amination includes tasks with respect to	the general u	understanding of the
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Structural Engineering	g: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Enginee	ring: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering:	Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Ele	ctive Compulsory		
	International Management and Engineering: Specialisa	tion II. Civil Engineering: Elective Compuls	ory	
	Theoretical Mechanical Engineering: Technical Comple	mentary Course: Elective Compulsory		

Course L0809: Harbour Engineering	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	SoSe
Content	 Fundamentals of harbor engineering Maritime transportation and waterways engineering Ships Elements of harbors Harbor approaches and water-side harbor areas Terminal design and handling of cargo Quay-walls and piers Equipment of harbors Sluices and other special constructions Connection to inland transportation / inland waterway transportation Protection of harbors Breakwaters and Jetties Wave protection of harbors Fishery and other small harbors
Literature	Brinkmann, B.: Seehäfen, Springer 2005

Course L1414: Harbour Engineering	
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0378: Port Planning	and Port Construction
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Frank Feindt
Language	DE
Cycle	SoSe
Content	 Planning and implementation of major projects Market analysis and traffic relations Planning process and plan Port planning in urban neighborhood Development of the logistics center "Port of Hamburg" in the metropolis Quays and waterfront structure Special planning Law Harbor - securing of a flexible use of the port Dimensioning of quays Flood protection structures Port of Hamburg - Infrastructure and development Preparation of areas Scour formation in front of shore structures
Literature	Vorlesungsumdruck, s. www.tu-harburg.de/gbt
Literature	Vorlesungsumdruck, s. www.tu-harburg.de/gbt

Module M0861: Mode	ling of Hydraulic Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Hydraulic Models (L0813)		Project-/problem-based Learning	1	1
Modelling of Waves (L0812)		Project-/problem-based Learning	1	1
Modelling of Flow in Rivers and Est	aries (L0810)	Lecture	3	4
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Coastal Hydraulic Engineering I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the followi	ng learning results		
Professional Competence				
Knowledge	Students are able to define in detail the basic processes that are related to the modelling of flows in hydraulic engineering			
	Besides, they can describe the basic aspects of numerical mode	elling and actual numerical mod	els for the sin	nulation of flows and
	waves.			
Skills	Students are able to apply hydrodynamic-numerical models to practical hydraulic engineering tasks.			
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge in simple applied problems. Additionally, they will be able to work in tear			
,	with others.		, .,	
Autonomy	The students will be able to independently extend their knowled	ge and apply it to new problems		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 3 hours. The examination	includes tasks with respect to	the general ι	understanding of the
scale	lecture contents and calculations tasks.		-	-
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective	Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elect	ive Compulsory		
-	Civil Engineering: Specialisation Coastal Engineering: Elective Co	ompulsory		

Course L0813: Hydraulic Models	
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE/EN
Cycle	SoSe
Content	 Fundamentals of hydraulic models Model laws Pi theorem of Buckingham Practical examples of hydraulic models
Literature	Strobl, Zunic: Wasserbau, Kap. 11 Hydraulische Modelle, Springer

Course L0812: Modelling of V	Naves
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE/EN
Cycle	SoSe
Content	 Waves, interactions with shallow water and constructions Wave theories Sea state and surges Development of waves Wave spectra Modelling of Waves / phase averaged and phase resolved models Application of a phase averaged model for wave prediction (SWAN) Application of phase resolved wave models (Mike)
Literature	Vorlesungsumdruck

Course L0810: Modelling of I	Flow in Rivers and Estuaries
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Dr. Edgar Nehlsen, Prof. Peter Fröhle
Language	DE/EN
Cycle	SoSe
Content	Basics of numerial models / application of models
	 classification of models model concept modelling 1D Working Equation Mathematical description of physical processes Equation of motions conservation of mass conservation of momentum Initial conditions and boundary conditions Numerical Methods Time step procedure Finite differences Finite volumes
Literature	Vorlesungsskript

Module M0874: Wast	ewater Systems			
Courses				
Title		Тур	Hrs/wk	CP
Wastewater Systems - Collection. 7	reatment and Reuse (L0934)	Lecture	2	2
Wastewater Systems - Collection, T	reatment and Reuse (L0943)	Recitation Section (large)	1	1
Advanced Wastewater Treatment (L0357)	Lecture	2	2
Advanced Wastewater Treatment (L0358)	Recitation Section (large)	1	1
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous	Knowledge of wastewater management and	the key processes involved in wastewater treat	ment.	
Knowledge				
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge	Students are able to outline key areas of the	e full range of treatment systems in waste wate	r management, a	s well as their mutua
	dependence for sustainable water protection	n. They can describe relevant economic, environ	mental and social	l factors.
<i></i>				6 H H H H H
Skills	Students are able to pre-design and explain	n the available wastewater treatment processe	s and the scope	of their application ii
	municipal and for some industrial treatment	plants.		
Personal Competence				
Social Competence	Social skills are not targeted in this module.			
Autonomy	Students are in a position to work on a su	ubject and to organize their work flow indepen	idently. They can	also present on this
	subject.			
Workload in Hours	Independent Study Time 96, Study Time in I	Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural E	ngineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnica	al Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Eng	ineering: Elective Compulsory		
	Civil Engineering: Specialisation Water and	Traffic: Compulsory		
	Bioprocess Engineering: Specialisation A - G	eneral Bioprocess Engineering: Elective Compuls	sory	
	Energy and Environmental Engineering: Spe	cialisation Environmental Engineering: Elective	Compulsory	
	Environmental Engineering: Specialisation W	Vater: Elective Compulsory		
	International Management and Engineering:	Specialisation II. Energy and Environmental Eng	jineering: Elective	Compulsory
	International Management and Engineering:	Specialisation II. Process Engineering and Biote	chnology: Elective	e Compulsory
	Process Engineering: Specialisation Environr	mental Process Engineering: Elective Compulsor	у	
	Process Engineering: Specialisation Process	Engineering: Elective Compulsory		
	Water and Environmental Engineering: Spec	ialisation Water: Compulsory		
	Water and Environmental Engineering: Spec	ialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Spec	ialisation Cities: Compulsory		

Course L0934: Wastewater S	ystems - Collection, Treatment and Reuse
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	SoSe
Content	•Understanding the global situation with water and wastewater
	•Regional planning and decentralised systems
	•Overview on innovative approaches
	•In depth knowledge on advanced wastewater treatment options for different situations, for end-of-pipe and reuse
	•Mathematical Modelling of Nitrogen Removal
	•Exercises with calculations and design
Literature	Henze, Mogens:
	Wastewater Treatment: Biological and Chemical Processes, Springer 2002, 430 pages
	George Tchobanoglous, Franklin L. Burton, H. David Stensel:
	Wastewater Engineering: Treatment and Reuse, Metcalf & Eddy
	McGraw-Hill, 2004 - 1819 pages

Course L0943: Wastewater Systems - Collection, Treatment and Reuse	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0357: Advanced Wa	stewater Treatment
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Joachim Behrendt
Language	EN
Cycle	SoSe
Content	Survey on advanced wastewater treatment
	reuse of reclaimed municipal wastewater
	Precipitation
	Flocculation
	Depth filtration
	Membrane Processes
	Activated carbon adsorption
	Ozonation
	"Advanced Oxidation Processes"
	Disinfection
Literature	Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003
	Wassertechnologie, H.H. Hahn, Springer-Verlag, Berlin 1987
	Membranverfahren: Grundlagen der Modul- und Anlagenauslegung, T. Melin und R. Rautenbach, Springer-Verlag, Berlin 2007
	Trinkwasserdesinfektion: Grundlagen, Verfahren, Anlagen, Geräte, Mikrobiologie, Chlorung, Ozonung, UV-Bestrahlung, Membranfiltration, Qualitätssicherung, W. Roeske, Oldenbourg-Verlag, München 2006
	Organische Problemstoffe in Abwässern, H. Gulyas, GFEU, Hamburg 2003

Course L0358: Advanced Wa	stewater Treatment
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Joachim Behrendt
Language	EN
Cycle	SoSe
Content	Aggregate organic compounds (sum parameters)
	Industrial wastewater
	Processes for industrial wastewater treatment
	Precipitation
	Flocculation
	Activated carbon adsorption
	Recalcitrant organic compounds
Literature	Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003
	Wassertechnologie, H.H. Hahn, Springer-Verlag, Berlin 1987
	Membranverfahren: Grundlagen der Modul- und Anlagenauslegung, T. Melin und R. Rautenbach, Springer-Verlag, Berlin 2007
	Trinkwasserdesinfektion: Grundlagen, Verfahren, Anlagen, Geräte, Mikrobiologie, Chlorung, Ozonung, UV-Bestrahlung,
	Membranfiltration, Qualitätssicherung, W. Roeske, Oldenbourg-Verlag, München 2006
	Organische Problemstoffe in Abwässern, H. Gulyas, GFEU, Hamburg 2003

Module M0922: City F	Planning		
Courses			
Title	Тур	Hrs/wk	СР
City Planning (L1066)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Carsten Gertz		
Admission Requirements	None		
Recommended Previous	for "Principles of Urban Planning": none		
Knowledge	for "Designing Urban Streetscapes": some knowledge of transport planning, e.g. through taking	the undergrad	luate class "Transpor
	Planning and Traffic Engineering"	5	
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	Students are able to:		
5			
	 use technical terms of urban planning. describe the main determinants of urban development. 		
	 describe the main determinants of urban development. explain and compare different possibilities of how urban development can be influenced. 		
	 discuss requirements for public streetscapes. 		
	explain the importance of street design.		
Skills	Students are able to:		
	 read and analyze urban development concepts and designs for streetscapes 		
	 appraise such concepts in the context of competing requirements. 		
	 design, justify and reflect their own solutions for concrete examples. 		
Personal Competence			
Social Competence	Students are able to:		
	discuss intermediate results with each other.		
	 constructively accept feedback on their own work. 		
	 provide constructive feedback to others. 		
Autonomy	Students are able to:		
	 independently complete a written report including drawings following a broadly pre-defin 	ed process.	
	 assess the consequences of their proposed solutions. 		
	 independently acquire knowledge and apply this to new issues or problem areas. 		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Credit points	6		
Course ankinger and	Nee-		
Course achievement	None Written elaboration		
Examination duration and	written assignment, designwork during the semester		
scale			
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory		
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective Comput	sory	
	Water and Environmental Engineering: Specialisation Water: Elective Compulsory		
	water and Environmental Engineering: Specialisation Environment: Elective Compulsory Water and Environmental Engineering: Specialisation Cities: Compulsory		
	water and Environmental Engineering. Specialisation cities. Compulsory		

Course L1066: City Planning	
Тур	Project-/problem-based Learning
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Carsten Gertz
Language	DE
Cycle	SoSe
Content	"Principles of Urban Planning" deals with the determinants of urban development and their interactions. Topics include:
	 legal framework, instruments and methods of planning, functional requirements, stakeholders and actors basic design requirements different planning levels and historical contexts. The objective of the course is for students to acquire a basic understanding of urban development problems and approaches for solving them. They will also be able to comprehend the process of urban planning. The course also covers the various functional and aesthetic requirements for designing streetscape as the most important elements of public space. The project work deals with a real life scenario and includes drawing up a development plan, an urban design concept, a building masterplan and a street redesign.
Literature	Albers, Gerd; Wekel, Julian (2009) Stadtplanung: Eine illustrierte Einführung. Primus Verlag. Darmstadt. Frick, Dieter (2008) Theorie des Städtebaus: Zur baulich-räumlichen Organisation von Stadt. Wasmuth-Verlag. Tübingen Jonas, Carsten (2009) Die Stadt und ihr Grundriss. Wasmuth-Verlag. Tübingen Kostof, Spiro; Castillo, Greg (1998) Die Anatomie der Stadt. Geschichte städtischer Strukturen. Campus-Verlag. Frankfurt/New York.

Module M0977: Const	ruction Logistics and Project Manage	ment		
Courses				
Title		Тур	Hrs/wk	СР
Construction Logistics (L1163)		Lecture	1	2
Construction Logistics (L1164)		Recitation Section (small)	1	2
Project Development and Managen	nent (L1161)	Lecture	1	1
Project Development and Managen	nent (L1162)	Project-/problem-based Learning	1	1
Module Responsible	Prof. Heike Flämig			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	ne following learning results		
Professional Competence				
Knowledge	Students can			
	 give definitions of the main terms of construction 	logistics and project development and n	nanagement	
	 name advantages and disadvantages of internal 	or external construction logistics		
	 explain characteristics of products, demand and 	production of construction objects and th	neir conseque	ences for construction
	specific supply chains			
	differentiate constructions logistics from other log	gistics systems		
Skills	Students can			
Skins				
	 carry out project life cycle assessments 			
	 apply methods and instruments of construction least 	ogistics		
	 apply methods and instruments of project development 	opment and management		
	 apply methods and instruments of conflict management 	gement		
	 design supply and waste removal concepts for a 	construction project		
Personal Competence				
Social Competence	Students can			
	 hold presentations in and for groups 			
	 apply methods of conflict solving skills in group v 	vork and case studies		
Autonomy	Students can			
	 solve problems by holistic, systemic and flow origination of the systemic and flow origination origination of the systemic and flow origination origination origination origination origination origination origination origination orine origination origination origination origination origination	ented thinking Rist and prices actution skills by analysis		f
	Improve their creativity, negotiation skills, cont studies	lict and crises solution skills by applyin	g methods o	r moderation in case
	studies			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Two written papers with presentations			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering:	Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineeri	ng: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: El	ective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elect	tive Compulsory		
	International Management and Engineering: Specialisat	ion II. Civil Engineering: Elective Compuls	ory	
	International Management and Engineering: Specialisat	ion II. Logistics: Elective Compulsory		
	Logistics, Infrastructure and Mobility: Specialisation Pro	duction and Logistics: Elective Compulso	'y	
	Logistics, Infrastructure and Mobility: Specialisation Infr	astructure and Mobility: Elective Compute	sory	
			-	

Course L1163: Construction	Logistics
Тур	Lecture
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Heike Flämig
Language	DE
Cycle	SoSe
Content	The lecture gives deeper insight how important logistics are as a competetive factor for construction projects and which issues are to be adressed. The following toppics are covered:
	 competetive factor logistics the concept of systems, planning and coordination of logistics material, equipment and reverse logistics IT in construction logistics elements of the planning model of construction logistics and their connections flow oriented logistics systems for construction projects logistics concepts for ready to use construction projects (especially procurement and waste removel logistics) best practice examples (construction logistics Potsdamer Platz, recent case study of the region)
Literature	 Flämig, Heike: Produktionslogistik in Stadtregionen. In: Forschungsverbund Ökologische Mobilität (Hrsg.) Forschungsbericht Bd. 15.2. Wuppertal 2000. Krauss, Siri: Die Baulogistik in der schlüsselfertigen Ausführung, Bauwerk Verlag GmbH Berlin 2005. Lipsmeier, Klaus: Abfallkennzahlen für Neubauleistungen im Hochbau : Verlag Forum für Abfallwirtschaft und Altlasten, 2004. Schmidt, Norbert: Wettbewerbsfaktor Baulogistik. Neue Wertschöpfungspotenziale in der Baustoffversorgung. In: Klaus, Peter: Edition Logistik. Band 6. Deutscher Verkehrs-Verlag. Hamburg 2003. Seemann, Y.F. (2007): Logistikkoordination als Organisationseinheit bei der Bauausführung Wissenschaftsverlag Mainz in Aachen, Aachen. (Mitteilungen aus dem Fachgebiet Baubetrieb und Bauwirtschaft (Hrsg. Kuhne, V.): Heft 20)

Course L1164: Construction Logistics	
Тур	Recitation Section (small)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Heike Flämig
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1161: Project Development and Management		
Тур	Lecture	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Heike Flämig, Dr. Anton Worobei	
Language	DE	
Cycle	SoSe	
Content	Within the lecture, the main aspects of project development and management are tought:	
	 Terms and definitions of project management Advantages and disadvantages of different ways of project handling organization, information, coordination and documentation cost and fincance management in projects time- and capacity management in projects specific methods and instruments for successful team work Contents of the lecture are deepened in special exercises.	
Literature	Projektmanagement-Fachmann. Band 1 und Band 2. RKW-Verlag, Eschborn, 2004.	

Course L1162: Project Development and Management	
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Heike Flämig, Dr. Anton Worobei
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0998: Static	s and Dynamics of Structures				
Courses					
Courses			_		
Title		1	Гур	Hrs/wk	СР
Structural Dynamics (L1202)		l	ecture	2	2
Structural Dynamics (L1203)	stool structures (LOE64)	F	Recitation Section (large)	2	2
Fracture mechanics and fatigue in	steel structures (L0565)	E	Recitation Section (Jarge)	1	1
		1	(ecitation Section (large)	1	1
Admission Requirements	Prof. Uwe Starossek				
Recommended Previous	Knowledge of linear structural analysis of sta	tically determinate	and indeterminate struct	res: Mechanics	I/II Mathematics I/I
Keconiniended Previous	Differential equations I	lucally determinate		ares, mechanics	
Knowledge					
Educational Objectives	After taking part successfully, students have re	ached the following	learning results		
Professional Competence					
Knowledge	After successful completion of this module, th	e student can exp	lain the basic aspects of d	ynamic effects or	n structures and the
	respective methods.				
Skills Personal Competence	After successful completion of this module, dynamics loading using the appropriate compu	the students will t tational approaches	be able to predict the res s and methods.	ponse of materia	al and structures to
Social Competence	Students can				
	 participate in subject-specific and interd 	isciplinary discussio	ins,		
	 defend their own work results in front of 	others			
	 promote the scientific development of contract 	olleagues			
	Furthermore, they can give and accept p	professional constru	ctive criticism		
Autonomy	Students are able to gain knowledge of the sul	oject area from give	en and other sources and a	pply it to new pro	blems. Furthermore
	they are able to structure the solution process	for problems in the	area of Structural Analysis.		
Workload in Hours	Independent Study Time 96, Study Time in Lec	ture 84			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	150 min				
scale					
Accimpont for the	Civil Engineering: Specialization Structural Fac	incoring Compulse	n /		
Eollowing Courting	Civil Engineering, Specialisation Structural Eng	neering. Compulso	i y o Compulson		
Following Curricula	Civil Engineering: Specialisation Geotechnical E		e compuisory		
	Civil Engineering: Specialisation Coastal Engine	fier Elective Com	ipuis0i y		
	Civil Engineering: Specialisation water and Tra	nic: Elective Compl	IISULY	ulcon.	
	international Management and Engineering: Sp	ecialisation II. Civil	Engineering: Elective Comp	Juisory	

Course L1202: Structural Dy	namics
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	SoSe
Content	 Single-degree-of-freedom systems: undamped and damped vibration, free vibration, forced vibrations due to harmonic, periodical or arbitrary loading, natural frequency, damping vibration isolation solution in the frequency-domain (Fourier transformation), solution in the time-domain multi-degree-of-freedom systems: continuous or discrete systems, modelling with finite elements, generalisation modal analysis power iteration according to v.Mises earthquake loading: seismological basics, response spectrum method wind-induced vibrations: engineering meteorology, aerodynamic, classification of excitation mechanisms
Literature	Clough, R.W., Penzien, J.: Dynamics of Structures. 2. Aufl., McGraw-Hill, New York, 1993.

Course L1203: Structural Dynamics	
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0564: Fracture mec	hanics and fatigue in steel structures
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Jürgen Priebe
Language	DE
Cycle	SoSe
Content	 basics of fatigue stress and fatigue resistance and determination of fatigue strength,
	 determination and use of S-N-curves and classification of notch effects,
	set up of determination of fatigue strength under dynamic load using the accumulation formula by Palmgren-Miner,
	set up of determination of fatigue strength in different examples,
	basics of construction and design regarding the problem of material fatigue,
	basics of linear elastic fracture mechanics under static and dynamic load,
	determination of lifetime of steel construction based on linear elastic fracture mechanics in different examples.
Literature	Seeßelberg, C.; Kranbahnen - Bemessung und konstruktive Gestaltung; 3. Auflage; Bauwerk-Verlag; Berlin 2009
	• Kuhlmann, Dürr, Günther; Kranbahnen und Betriebsfestigkeit; in Stahlbau Kalender 2003; Verlag Ernst & Sohn; Berlin 2003
	Deutscher Stahlbau-Verband (Hrsg.); Stahlbau Handbuch Band 1 Teil B; 3. Auflage; Stahlbau-Verlagsgesellschaft; Köln 1996
	Petersen, C.; Stahlbau; 3. überarb. und erw. Auflage; Vieweg-Verlag; Braunschweig 1993
	• DIN V ENV 1993-1-1: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 1-1: Allgemeine Bemessungsregeln, Bemessungsregeln für den Hochbau; 1993
	• DIN V ENV 1993-6: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 6: Kranbahnen; 2001
	DIN-Fachbericht 126. Richtlinie zur Anwendung von DIN V ENV 1993-6; Nationales Anwendungsdokument (NAD); Berlin 2002

Course L0565: Fracture mechanics and fatigue in steel structures	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Jürgen Priebe
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0999: Steel	Construction Project				
Courses					
Title		Тур	Hrs/wk	СР	
Steel Construction Project (L1206)		Project Seminar	4	6	
Module Responsible	Prof. Marcus Rutner				
Admission Requirements	None				
Recommended Previous	Steel and Composite Structures				
Knowledge					
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results			
Professional Competence					
Knowledge	Students are able to prepare a part of the	whole project and explain it to the others.			
Skills	Students can produce sketches and calc	ulations of their part of the project. They a	are able to adjust their	work in react	tion to
	changing conditions resulting from other p	articipants of the project.			
Personal Competence					
Social Competence	Students can present their results to other	members of the group.			
	They have the ability to work for a broad a	greement with respect to intergroup depend	dencies.		
	They can distribute and process tasks inde	ependently.			
Autonomy	Students can handle their part of the proje	ct on their own resposibility-			
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56			
Credit points	6				
Course achievement	None				
Examination	Written elaboration				
Examination duration and	approx. 15-20 pages (without appendix)				
scale					
Assignment for the	Civil Engineering: Specialisation Geotechni	ical Engineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Coastal Er	ngineering: Elective Compulsory			
	Civil Engineering: Specialisation Structural	Engineering: Compulsory			

Course L1206: Steel Construction Project	
Тур	Project Seminar
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Marcus Rutner
Language	DE
Cycle	SoSe
Content	Design of a big construction project (i.e skyscraper, large bridge, roof of a stadiuim) in small groups
Literature	Wird je nach Projekt individuell angegeben.

Module M0663: Marir	e Geotechnics			
Courses				
Title		Тур	Hrs/wk	СР
Marine Geotechnics (L0548)		Lecture	1	2
Marine Geotechnics (L0549)		Recitation Section (large)	2	2
Steel Structures in Foundation and	Hydraulic Engineering (L1146)	Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous	complete modules: Geotechnics I-III, Mathen	natics I-III		
Knowledge	courses: Soil laboratory course			
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnica	al Engineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Structural E	ngineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Eng	ineering: Compulsory		
	Theoretical Mechanical Engineering: Special	isation Maritime Technology: Elective Compulso	ry	
	Theoretical Mechanical Engineering: Technic	al Complementary Course: Elective Compulsory		
	Water and Environmental Engineering: Spec	ialisation Cities: Elective Compulsory		
	Water and Environmental Engineering: Spec	ialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Spec	ialisation Water: Elective Compulsory		

Course L0548: Marine Geotechnics		
Тур	Lecture	
Hrs/wk	1	
CP	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Jürgen Grabe	
Language	DE	
Cycle	SoSe	
Content	 Geotechnical investigation an description of the seabed Foundations of Offshore-Constructions cCliff erosion Sea dikes Port structures Flood protection structures 	
Literature	 EAK (2002): Empfehlungen für Küstenschutzbauwerke EAU (2004): Empfehlungen des Arbeitsausschusses Uferbauwerke Poulos H.G. (1988): Marine Geotechnics. Unwin Hyman, London Wagner P. (1990): Meerestechnik: Eine Einführung für Bauingenieure. Ernst & Sohn, Berlin 	

Course L0549: Marine Geotechnics	
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1146: Steel Structures in Foundation and Hydraulic Engineering		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Frank Feindt	
Language	DE	
Cycle	SoSe	
Content	Design of a sheet pile wall, design of a combined sheet pile wall, piles, walings, connections, fatigue	
Literature	EAU 2012, EA-Pfähle, EAB	

Module M1350: Excav	ation Law and Projects			
Courses				
Title		Тур	Hrs/wk	СР
Subsoil and Underground Engineering Law (L0395)		Lecture	2	2
Service Contract and Procurement Law (L1906)		Lecture	2	2
Project Geotechnics (L0708)		Project-/problem-based Learning	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fol	lowing learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and	30 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Electiv	e Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: E	lective Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Elec	tive Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective C	Compulsory		

Course L0395: Subsoil and Underground Engineering Law		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Günther Schalk	
Language	DE	
Cycle	WiSe	
Content	History of Civil Engineering Law (from 1700 BC to 2000 AD)	
	• Basics of foundation and excarvation law / engineering law (the participants in the case law of geotechnical law case studies)	
	• Legal aspects of technical regulations in civil engineering (with case studies)	
	• The civil engineering contract (including checklists for the special civil engineering contract design and execution)	
	• The liability of the planner and entrepreneur in civil engineering (practical examples, jurisprudence and law, inter alia, to the Ordinance on Combatants, liability for defects and traffic safety obligations, construction law and insurance questions)	
	• The ground / foundation risk and the systemic risk (also in the European context)	
	The total debt in (low) building law (based on practice-oriented case constellations)	
	• The (construction) conflict, the dispute avoidance models and the construction process (practice-oriented presentation)	
Literature	Folienskript (in der Vorlesung erhältlich)	
	weitere Literatur:	
	Englert, Grauvogel und Maurer: Handbuch des Baugrund- und Tiefbaurechts. Werner-Verlag	

Course L1906: Service Contract and Procurement Law	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Günther Schalk, Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	
Literature	

Module Manual M.Sc. "Civil Engineering"

Course L0708: Project Geotechnics				
Тур	Project-/problem-based Learning			
Hrs/wk	2			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Jürgen Grabe			
Language	DE			
Cycle	WiSe			
Content	The students solve independently a project-based geotechnical problem in groups. Additional lectures concerning the problem will			
	be held and material will be distributed as study basis. Every two weeks the groups present their current project status. The final			
	work will be presentated in a final presentation.			
Literature	abhängig von der Fragestellung			
Module M1716: Subs	urface Processes			
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Courses				
Title		Тур	Hrs/wk	СР
Modeling of Subsurface Processes	(L2730)	Lecture	2	2
Modeling of Subsurface Processes	(L2731)	Recitation Section (small)	1	1
Modern Techniques for Subsurface	Solute Transport (L2728)	Lecture	2	2
Modern Techniques for Subsurface	Solute Transport (L2729)	Recitation Section (large)	1	1
Module Responsible	Prof. Nima Shokri			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reac	hed the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lectur	e 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engine	ering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Eng	ineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineer	ing: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic	: Elective Compulsory		
	Process Engineering: Specialisation Environmenta	I Process Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process Engin	eering: Elective Compulsory		
	Water and Environmental Engineering: Specialisat	tion Water: Compulsory		
	Water and Environmental Engineering: Specialisat	tion Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisa	tion Cities: Elective Compulsory		

Course L2730: Modeling of Subsurface Processes	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Sonja Götz
Language	EN
Cycle	WiSe
Content	
Literature	

Course L2731: Modeling of Subsurface Processes	
Тур	Recitation Section (small)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Sonja Götz
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L2728: Modern Techniques for Subsurface Solute Transport	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Nima Shokri
Language	EN
Cycle	WiSe
Content	
Literature	

Course L2729: Modern Techniques for Subsurface Solute Transport	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Hannes Nevermann
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1437: Non c	lestructive testing of materials and part	S		
Courses				
Title		Тур	Hrs/wk	СР
Non destructive testing of material	s and parts (L2215)	Lecture	2	2
Non destructive testing of material	s and parts (L2217)	Project-/problem-based Learning	3	3
Non destructive testing of material	s and parts (L2216)	Recitation Section (large)	1	1
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the f	ollowing learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Written document about theory and praxis			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Elect	ive Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Elect	ive Compulsory		
	Civil Engineering: Specialisation Geotechnical Engineering:	Elective Compulsory		
	Civil Engineering: Specialisation Geotechnical Engineering:	Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Ele	ective Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Ele	ective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective	Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective	e Compulsory		
	Materials Science: Specialisation Engineering Materials: Ele	ective Compulsory		

Course L2215: Non destructi	ve testing of materials and parts
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Marcus Rutner, Prof. Robert Meißner
Language	DE/EN
Cycle	WiSe
Content	This strongly interdisciplinary lecture and practical course is offered to Masterstudents who are interesed to learn about an
	important field across engineering and material science industries, i.e. nondestructive testing of materials and parts.
	Interdisciplinary approaches and thinking becomes more and more important since many problems extend into various disciplines,
	hence, can only be solved through interdisciplinary thinking and collaboration. Accordingly, this module combines the efforts of 4
	different disciplines, i.e. mechanical engineering, civil engineering, materials science and computer science with a touch of
	electrical engineering. Nondestructive testing (NDT) is the process of inspecting, testing, and evaluating materials, parts, and
	assemblies to understand properties and defects without causing damage to the material or part. This scientific approach enables
	to make intrinsic material and component characteristics visible. Hence, the approach links detection approaches (e.g. linear and
	nonlinear acoustic methods, ultrasonic testing, Magnetic Particle Testing, thermo-chemical methods, etc.) with material physics
	and the mechanics of components, further, with evaluation, interpretation, big data management, transmission of data, and
	cybersecurity. The module embraces a lecture and a practical course. Contents of the lecture are NTD technologies and their
	theory behind, evaluation, transmission of data, while the students will apply the NDT technologies during the practical course in
	the experimental test halls and labs at TUHH. Lecture and practical course split into the major themes: A) Detection: Theory and
	Practice B) Evaluation of Data: Theory and Practice C) Data Acquisition and Transmission with Wireless, Batteryless Sensor
	Devices:Theory and Practice
Literature	

Course L2217: Non destructive testing of materials and parts	
Тур	Project-/problem-based Learning
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Marcus Rutner, Prof. Robert Meißner
Language	DE/EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L2216: Non destructi	ve testing of materials and parts
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Marcus Rutner, Prof. Robert Meißner
Language	DE/EN
Cycle	WiSe
Content	This strongly interdisciplinary lecture and practical course is offered to Masterstudents who are interesed to learn about an
	important field across engineering and material science industries, i.e. nondestructive testing of materials and parts.
	Interdisciplinary approaches and thinking becomes more and more important since many problems extend into various disciplines,
	hence, can only be solved through interdisciplinary thinking and collaboration. Accordingly, this module combines the efforts of 4
	different disciplines, i.e. mechanical engineering, civil engineering, materials science and computer science with a touch of
	electrical engineering. Nondestructive testing (NDT) is the process of inspecting, testing, and evaluating materials, parts, and
	assemblies to understand properties and defects without causing damage to the material or part. This scientific approach enables
	to make intrinsic material and component characteristics visible. Hence, the approach links detection approaches (e.g. linear and
	nonlinear acoustic methods, ultrasonic testing, Magnetic Particle Testing, thermo-chemical methods, etc.) with material physics
	and the mechanics of components, further, with evaluation, interpretation, big data management, transmission of data, and
	cybersecurity. The module embraces a lecture and a practical course. Contents of the lecture are NTD technologies and their
	theory behind, evaluation, transmission of data, while the students will apply the NDT technologies during the practical course in
	the experimental test halls and labs at TUHH. Lecture and practical course split into the major themes: A) Detection: Theory and
	Practice B) Evaluation of Data: Theory and Practice C) Data Acquisition and Transmission with Wireless, Batteryless Sensor
	Devices:Theory and Practice
Literature	

Module M0581: Wate	r Protection			
Courses				
Title		Тур	Hrs/wk	СР
Water Protection and Wastewater M	lanagement (L0226)	Lecture	3	3
Water Protection and Wastewater N	Aanagement (L2008)	Project Seminar	3	3
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous	Basic knowledge in water manageme	ent;		
Kilowiedge	 Good knowledge in urban drainage; 			
	 Good knowledge of wastewater treat 	ment techniques;		
	 Good knowledge of pollutants (e.g. C 	OD, BOD, TS, N, P) and their properties;		
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge	The students can describe the basic princip	les of the regulatory framework related to the	international and Eu	Iropean water sector
	They can explain limnological processes,	substance cycles and water morphology in d	etail. They are able	e to assess complex
	problems related to water protection, such	n as ecosystem service and wastewater treat	ment with a special	focus on innovative
	solutions, remediation measures as well as	conceptual approaches.		
Skills	Students can accurately assess current pro	blems and situations in a country-specific or l	ocal context. They o	can suggest concrete
	actions to contribute to the planning of t	omorrow's urban water cycle. Furthermore, t	hey can suggest a	ppropriate technical
	administrative and legislative solutions to s	olve these problems.		
Personal Competence				
Social Competence	The students can work together in internation	onal groups.		
Autonomy	Students are able to organize their work flo	ow to prepare presentations and discussions.	They can acquire ap	propriate knowledge
	by making enquiries independently.			
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
Credit points	6	-		
Course achievement	None			
Examination	Presentation			
Examination duration and	Term paper plus presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Structural R	Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnic	al Engineering: Elective Compulsory		
3 • • • • • • • •	Civil Engineering: Specialisation Coastal Eng	gineering: Elective Compulsory		
	Civil Engineering: Specialisation Water and	Traffic: Elective Compulsory		
	Environmental Engineering: Specialisation V	Nater: Elective Compulsory		
	International Management and Engineering	: Specialisation II. Civil Engineering: Elective Co	ompulsory	
	Joint European Master in Environmental Stu	dies - Cities and Sustainability: Specialisation V	Vater: Elective Comp	oulsory
	Water and Environmental Engineering: Spec	cialisation Cities: Elective Compulsory		
	Water and Environmental Engineering: Spec	cialisation Water: Elective Compulsory		
	water and Environmental Engineering: Spec	ciansation Environment: Compulsory		

Course L0226: Water Protect	ion and Wastewater Management
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	WiSe
Content	The lecture focusses on:
	Regulatory Framework (e.g. WFD)
	Main instruments for the water management and protection
	 In depth knowledge of relevant measures of water pollution control
	Urban drainage, treatment options in different regions on the world
	• Rainwater management, improved management of heavy rainfalls, downpours, rainwater harvesting, rainwater infiltration
	Case Studies and Field Trips
Literature	The literature listed below is available in the library of the TUHH.
	 Water and wastewater technology Hammer, M. J. 1., & . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Education International. Water and wastewater engineering : design principles and practice: Davis, M. L. 1. (2011) New York, NY: McGraw-Hill. Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ.

Course L2008: Water Protection and Wastewater Management	
Тур	Project Seminar
Hrs/wk	3
CP	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	WiSe
Content	
Literature	

Module M0595: Exam	ination of Materials, Structural Cor	dition and Damages		
Courses				
Title		Тур	Hrs/wk	СР
Examination of Materials, Structura	l Condition and Damages (L0260)	Lecture	3	4
Examination of Materials, Structura	l Condition and Damages (L0261)	Recitation Section (small)	1	2
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous	Basic knowledge about building materials or ma	aterial science, for example by the mod	ule Building M	aterials and Building
Knowledge	Chemistry.			
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge	The students are able to describe the rules for tra methods for the testing of building material proper testing methods.	ding, use and marking of construction pro ties are usable and know the limitations an	ducts in Germa d characterics	ny. They know which of the most important
Skills	The students are able to responsibly discover the ru They are able to chose suitable methods for the te the examination of the structural conditions of buil are able to describe an examination in form of a te	ules for trading and using of building produ- sting and inspection of construction produc dings. They are able to conclude from symp st report or expert opinion.	cts in Germany. cts, the examina otons to the car	ation of damages and use of damages. They
Personal Competence Social Competence	The students can describe the different roles of m framework of material testing. They can describe th	anufacturers as well as testing, supervisor ne different roles of the participants in legal	y and certificat proceedings.	tion bodies within the
Autonomy	The students are able to make the timing and the o	peration steps to learn the specialist knowl	edge of a very	extensive field.
Workload in Hours	Independent Study Time 124, Study Time in Lecture	e 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineer	ring: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engir	eering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineerin	g: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic:	Elective Compulsory		
	International Management and Engineering: Specia	lisation II. Civil Engineering: Elective Comp	ulsory	
	Materials Science: Specialisation Engineering Mater	ials: Elective Compulsory		

Course L0260: Examination of Materials, Structural Condition and Damages Typ Lecture Uesture 3 OP 4 Workload in Hours Independent Study Time 78, Study Time in Lecture 42 Lecture Prof. Frank Schmidt-Döhl Lectured DE Content Materials testing and marking process of construction products, testing methods for building materials and structures, testing reports and expert opinions, describing the condition of a structure, from symptons to the cause of damages Literature Frank Schmidt-Döhl: Materialprüfung im Bauwesen. Fraunhofer irb-Verlag, Stuttgart, 2013.

Course L0261: Examination of Materials, Structural Condition and Damages			
Тур	Recitation Section (small)		
Hrs/wk	1		
СР	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Frank Schmidt-Döhl		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M0619: Waste	e Treatment Techn	ologies				
Courses						
Title				Тур	Hrs/wk	СР
Waste and Environmental Chemist	ry (L0328)			Practical Course	2	2
Biological Waste Treatment (L0318)			Project-/problem-based Learning	3	4
Module Responsible	Prof. Kerstin Kuchta					
Admission Requirements	None					
Recommended Previous	chemical and biological ba	sics				
Knowledge						
Educational Objectives	After taking part successfu	Illy, students have re	eached the followi	ng learning results		
Professional Competence						
Knowledge	The module aims possess	knowledge concerni	ng the planning of	biological waste treatment plan	ts. Students ar	e able to explain the
	design and layout of anaer	obic and aerobic wa	ste treatment pla	nts in detail, describe different t	echniques for v	waste gas treatment
	plants for biological waste	treatment plants an	d explain different	t methods for waste analytics.		
<i>CL 11</i>	- 1					d
SKIIIS	The students are able to d	e students can rech	on of design and is	ayout of plants. They can critical	ly evaluate tec	chniques and quality
	and plan additional tests	They are capable of	reflecting and evaluation	luating findings in the group		
			i chicecung and era			
Personal Competence						
Social Competence	Students can participate i	n subject-specific ar	nd interdisciplinary	/ discussions, develop cooperate	ed solutions ar	nd defend their own
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	work results in front of o	thers and promote	the scientific dev	elopment in front of colleagues	. Furthermore,	they can give and
	accept professional constr	uctive criticism.				
Autonomy	Students can independent	ly tap knowledge fr	om literature, bus	iness or test reports and transfo	orm it to the co	ourse projects. They
	are capable, in consultatio	n with supervisors a	s well as in the int	erim presentation, to assess the	ir learning leve	el and define further
	steps on this basis. Furthe	ermore, they can de	fine targets for ne	ew application-or research-orien	ted duties in a	accordance with the
	potential social, economic	and cultural impact.				
		10 CL 1 The 1 L				
Credit points	independent Study Time I	10, Study Time in Le	ecture 70			
Course achievement	Compulsory Bonus For	n	Description			
course acmevement	Yes None Sub	ject theoretical	and			
	pra	ctical work				
Examination	Presentation					
Examination duration and	Elaboration and Presentati	on (15-25 minutes ir	n groups)			
scale						
Assignment for the	Civil Engineering: Specialis	ation Structural Eng	ineering: Elective	Compulsory		
Following Curricula	Civil Engineering: Specialis	ation Geotechnical I	Engineering: Elect	ive Compulsory		
	Civil Engineering: Specialis	ation Coastal Engine	eering: Elective Co	ompulsory		
	Civil Engineering: Specialis	ation Water and Tra	ffic: Elective Com	pulsory		
	Energy and Environmental	Engineering: Specia	lisation Environm	ental Engineering: Elective Com	oulsory	
	Environmental Engineering	g: Core Qualification:	Compulsory	argu and Environmental Engines	ring, Elective (Compulson
	International Management	and Engineering: Sp nvironmental Studie	s - Cities and Sust	ainability: Specialisation Energy	Flective Com	Lompulsory
	Water and Environmental	Engineering: Special	isation Cities. Flee	tive Compulsory	Liective Comp	Juisory
	Water and Environmental	Engineering: Special	isation Environme	nt: Elective Compulsory		
		5 ··· ·5· ·p· ·o		· · · · · · · · · · · · · · · · · · ·		

Course L0328: Waste and En	vironmental Chemistry
Тур	Practical Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Kerstin Kuchta
Language	DE/EN
Cycle	WiSe
Content	The participants are divided into groups. Each group prepares a transcript on the experiment performed, which is then used as basis for discussing the results and to evaluate the performance of the group and the individual student. In some experiments the test procedure and the results are presented in seminar form, accompanied by discussion and results evaluation. Experiments ar e.g. Screening and particle size determination Fos/Tac AAS Chalorific value
Literature	Scripte

Course L0318: Biological Waste Treatment				
Тур	Project-/problem-based Learning			
Hrs/wk	3			
СР	4			
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42			
Lecturer	Prof. Kerstin Kuchta			
Language	EN			
Cycle	WiSe			
Content	 Introduction biological basics determination process specific material characterization aerobic degradation (Composting, stabilization) anaerobic degradation (Biogas production, fermentation) Technical layout and process design Flue gas treatment Plant design practical phase 			
Literature				

Module M0713: Concr	ete Structures	;				
Courses						
Title				Тур	Hrs/wk	СР
Concrete Structures (L0579)				Seminar	1	1
Structural Concrete Members (L057	77)			Lecture	2	3
Structural Concrete Members (L057	(8)			Recitation Section (large)	2	2
Module Responsible	Prof. Günter Rombac	h				
Admission Requirements	None					
Recommended Previous	Basics of structural a	nalysis, conception a	nd dimensioning of str	uctural concrete		
Knowledge	Madulaa, Dainfanaad	Commente Chrysteines I		LUU Mashanian Luu		
	Modules: Reinforced	Concrete Structures I	+II, Structural Analysis	1+II, Mechanics I+II		
Educational Objectives	After taking part suc	cessfully students ha	ve reached the followi	na learnina results		
Professional Competence	, and the second second	costany, statents na				
Knowledge	The students broade	n their skills in struct	ural onginooring ocno	cially in the field of building	s (houses roofs h	alls) They dispose
Knowledge	the knowledge for th	a conception and dec	ian of concrete buildin	as and structural members	that are often used	alis). They dispose
	the knowledge for th	e conception and des	ight of concrete buildin		that are often used	
Skills	The students are able to apply procedures of the conception and dimensioning to to practical problems of structural engineering.					
	They are capable to draft concrete buildings and to design them for general action effects and to plan their detailing and					
	execution. Moreover, they can make design and construction sketches and draw up technical descriptions.					
Personal Competence						
Social Competence	The students are able to obtain results of high quality in teamwork.					
Autonomv	The students are abl	e to carry out comple	x conception and dime	nsioning tasks of structures	s under the guidan	ce of tutors.
		,		5		
Workload in Hours	Independent Study T	ime 110, Study Time	in Lecture 70			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	Yes None	Presentation	Es werden 2	Referate ausgegeben		
Examination	Written exam					
Examination duration and	120 minutes					
scale						
Assignment for the	Civil Engineering: Sp	ecialisation Structural	Engineering: Compuls	sory		
Following Curricula	Civil Engineering: Sp	ecialisation Geotechn	ical Engineering: Elect	ive Compulsory		
	Civil Engineering: Sp	ecialisation Coastal E	ngineering: Elective Co	ompulsory		
	Civil Engineering: Sp	ecialisation Water and	d Traffic: Elective Com	pulsory		
	International Manage	ement and Engineerin	g: Specialisation II. Civ	il Engineering: Elective Cor	npulsory	
		-				

Course L0579: Concrete Stru	Inclures
Тур	Seminar
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	WiSe
Content	With help of a project teamwork the subjects of the course "Concrete Structures" is practiced, discussed and presented.
Literature	- Projektbezogene Unterlagen werden abgegeben.

Course L0577: Structural Cor	ncrete Members
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	WiSe
Content	 skyscrapers: structural elements actions on structrues bracing systems design orf slabs (line and point supported plates and floor slabs) membranes and deep beams folded plates and shells truss models reinforced and prestressed members
Literature	 Voriesungsünterlagen können im STUDIP nerüntergeladen werden Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003 Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012 Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalender 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992 Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin 1973 Schlaich J.; Schäfer K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721ff, Verlag Ernst & Sohn, Berlin, 1998 Dames KH.: Rohbauzeichnungen Bewehrungszeichnungen. Bauverlag, Wiesbaden 1997

ourse L0578: Structural Concrete Members				
Тур	Recitation Section (large)			
Hrs/wk	2			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Günter Rombach			
Language	DE			
Cycle	WiSe			
Content	See interlocking course			
Literature	See interlocking course			

Module M0722: Comp	utation	al Ana	lysis of Concr	ete Structures			
Courses							
Title					Тур	Hrs/wk	СР
Computational Analysis of Concrete	e Structures	(L0598)			Lecture	2	3
Computational Analysis of Concrete	e Structures	(L0599)			Recitation Section (large)	1	1
FE-Modeling of Concrete Structures	s (L0600)				Project-/problem-based Learning	2	2
Module Responsible	Prof. Günte	er Romba	ch				
Admission Requirements	None						
Recommended Previous	Basic know	ledge in	structural analysis a	and design of reinforced	concrete structures (beams, slab	s, shear walls).
Knowledge	Lectures '	Concrete	Structures I und II'				
	Lectures '	Structura	l Analysis I and II'				
	Lecture 'Co	oncrete S	tructures'				
Educational Objectives	After takin	g part su	ccessfully, students	have reached the follow	ing learning results		
Professional Competence							
Knowledge	The studer	The students know the problems of numerical modeling and design of an arbitrary concrete structure.					
Skills	The studer	The students can model and design an arbitrary concrete structure by means of a finite element software package.					
Personal Competence							
Social Competence	The studer	The students can model and design in teamwork a real concrete structure by means of a finite element software package					
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,							
Autonomy	The studer	nts can m	odel and design a re	eal concrete structure ba	sed on a finite element software	package and	discuss the problems
	and results	and results with other students.					
Workload in Hours	Independe	nt Study	Time 110, Study Tin	ne in Lecture 70			
Credit points	6						
Course achievement	Compulsory	Bonus	Form	Description			
	Yes	None	Excercises	Es ist ein Tra	agsystem mit TEDDY zu modellie	ren	
	Yes	None	Attestation	Am Ende d	es Semster ist ein Tragsysten	n mit dem R	echenprogramm zu
				modellieren			
Examination	Oral exam						
Examination duration and	45 min						
scale							
Assignment for the	Civil Engin	eering: S	pecialisation Structu	Iral Engineering: Elective	Compulsory		
Following Curricula	Civil Engin	eering: S	pecialisation Geotec	hnical Engineering: Elec	tive Compulsory		
	Civil Engin	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory					
	Civil Engin	eering: S	pecialisation Water a	and Traffic: Elective Com	ipulsory		

Course L0598: Computationa	I Analysis of Concrete Structures
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	WiSe
Content	 Modeling of beam and truss structures Discontinuity regions, like frame corners, openings, shear walls with large openings Bracing of high-rise buildings Modeling of bridges Nonlinear analysis Finite-Elemente-analysis of slabs: support conditions, singularity regions Finite-Elemente-Berechnungen of shear walls and deep beams: support condition, design Coupled systems Modeling of slab supported on beams Shell structures 3D building models Nonlinear analysis of slabs and shells Documentation
Literature	 Vorlesungsumdruck Rombach, G.A. (2007): Anwendung der Finite-Elemente-Methode im Betonbau. 2. Auflage, Verlag Ernst & Sohn, Berlin Rombach G.A. (2011): Finite-Element Design of Concrete Structures, 2nd edition, ICE publishing Hartmann, F., Katz, C. (2002): Statik mit finiten Elementen. Springer, Berlin

Course L0599: Computational Analysis of Concrete Structures			
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Günter Rombach		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L0600: FE-Modeling o	of Concrete Structures
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Lukas Henze
Language	DE
Cycle	WiSe
Content	Finite Element Modeling and computational design of concrete structures by 'SOFiSTiK'
Literature	 Rombach G.: Anwendung der Finite - Elemente - Methode im Betonbau. 2. Auflage. Verlag Ernst & Sohn, Berlin, 2007 Rombach G.: Finite-Element Design of Concrete Structures. 2nd edition, ICE Publishing, London, 2011, ISBN 0 7277 32749 Rombach G.: EDV-unterstützte Berechnungen im Stahlbetonbau. in: "Stahlbetonbau aktuell 2014" (ed. Gorris A., Hegger J., Mark P.), Berlin 2014 (S. C1C.36)

Module M0801: Water Resources and -Supply					
Courses					
Title	Typ Hrs/wk CP			СР	
Chemistry of Drinking Water Treat	ment (L0311)	Lectur	e	2	1
Chemistry of Drinking Water Treat	ment (L0312)	Recita	tion Section (large)	1	2
Water Resource Management (L04	02)	Lectur	e	2	2
Water Resource Management (L04	03)	Recita	tion Section (small)	1	1
Module Responsible	Prof. Mathias Ernst				
Admission Requirements	None				
Recommended Previous	Knowledge of water management and the ke	ey processes involved in wa	ter treatment.		
Knowledge					
Educational Objectives	After taking part successfully, students have	e reached the following lear	ning results		
Professional Competence					
Skills	water supply. They will understand relevant economic, environmental and social factors. Students will be able to explain and outline the organisational structures of water companies. They will be able to explain the available water treatment processes and the scope of their application. Students will be able to assess complex problems in drinking water production and establish solutions involving water management and technical measures. They will be able to assess the evaluation methods that can be used for this. Students will be able to carry out chemical calculations for selected treatment processes and apply generally accepted technical rules and standards to these processes.				
Personal Competence Social Competence	Working in a diverse group of specialists, students will be able to develop and document complex solutions for the management				
	interests. They will be able to develop joint s	solutions in teams of diverse	e experts and present	these solutions t	o others.
Autonomy	Students will be in a position to work on a su	bject independently and pr	esent on this subject.		
Workload in Hours	Independent Study Time 96, Study Time in L	ecture 84			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	60 min (chemistry) + presentation				
scale					
Assignment for the	Civil Engineering: Specialisation Structural Engineering	ngineering: Elective Compu	Ilsory		
Following Curricula	Civil Engineering: Specialisation Geotechnica	al Engineering: Elective Cor	npulsory		
_	Civil Engineering: Specialisation Water and T	Traffic: Compulsory			
	Civil Engineering: Specialisation Coastal Engi	ineering: Elective Compulse	ory		
	International Management and Engineering:	Specialisation II. Energy an	d Environmental Engir	neering: Elective	Compulsory
	Water and Environmental Engineering: Speci	ialisation Water: Compulso	Ŷ		
	Water and Environmental Engineering: Speci	ialisation Environment: Elec	tive Compulsory		
	Water and Environmental Engineering: Speci	ialisation Cities: Elective Co	mpulsory		

Course L0311: Chemistry of I	Drinking Water Treatment
Тур	Lecture
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dr. Klaus Johannsen
Language	DE
Cycle	WiSe
Content	The topic of this course is water chemistry with respect to drinking water treatment and water distribution
	Major topics are solubility of gases, carbonic acid system and calcium carbonate, blending, softening, redox processes, materials and legal requirements on drinking water treatment. Focus is put on generally accepted rules of technology (DVGW- and DIN- standards). Special emphasis is put on calculations using realistic analysis data (e.g. calculation of pH or calcium carbonate dissolution potential) in exercises. Students can get a feedback and gain extra points for exam by solving problems for homework. Knowledge of drinking water treatment processes is vital for this lecture. Therefore the most important processes are explained coordinated with the course " Water resources management" in the beginning of the semester.
Literature	 MHW (rev. by Crittenden, J. et al.): Water treatment principles and design. John Wiley & Sons, Hoboken, 2005. Stumm, W., Morgan, J.J.: Aquatic chemistry. John Wiley & Sons, New York, 1996. DVGW (Hrsg.): Wasseraufbereitung - Grundlagen und Verfahren. Oldenbourg Industrie Verlag, München, 2004. Jensen, J. N.: A Problem Solving Approach to Aquatic Chemistry. John Wiley & Sons, Inc., New York, 2003.

Course L0312: Chemistry of Drinking Water Treatment	
Тур	Recitation Section (large)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Dr. Klaus Johannsen
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L0402: Water Resource Management		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Mathias Ernst	
Language	DE	
Cycle	WiSe	
Content	The lecture provides comprehensive knowledge on interaction of water ressource management and drinking water supply. Content	
	overview: • Current situation of global water resources • User and Stakeholder conflicts • Wasserressourcenmanagement in urbane Gebieten • Rechtliche Aspekte, Organisationsformen Trinkwasserversorgungsunternehmen. • Ökobilanzierung, Benchmarking in der Wasserversorgung	
Literature	 Aktuelle UN World Water Development Reports Branchenbild der deutschen Wasserwirtschaft, VKU (2011) Aktuelle Artikel wissenschaftlicher Zeitschriften Ppt der Vorlesung 	

Course L0403: Water Resource Management	
Тур	Recitation Section (small)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Mathias Ernst
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

-	
Courses	
ïtle	Typ Hrs/wk CP
ntegrated Transportation Planning	(L1068) Project-/problem-based Learning 4 6
Module Responsible	Prof. Carsten Gertz
Admission Requirements	None
Recommended Previous	some knowledge of transport planning, e.g. through taking the undergraduate class "Transport Planning and Traffic Engineerin
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to:
	describe interdependencies between land-use/location choice and transportation/mobility behaviour
	 explain and evaluate the social, ecological and economic effects of transport and land-use policy measures.
	 relate current issues in the area of integrated transport planning and formulate an opinion on them.
Skills	Students are able to:
	 quantify important parameters, which influence travel demand or are influenced by it. comprehensively examine a pre-defined or self-selected topic from a transportation studies perspective and document the selected topic from a transportation studies perspective and document the selected topic from a transportation studies perspective and document the selected topic from a transportation studies perspective and document the selected topic from a transportation studies perspective and document the selected topic from a transportation studies perspective and document the selected topic from a transportation studies perspective and document the selected topic from a transportation studies perspective and document the selected topic from a transportation studies perspective and document the selected topic from a transportation studies perspective and document the selected topic from a transportation studies perspective and document the selected topic from a transportation studies perspective and document the selected topic from a transportation studies perspective and document the selected topic from a transportation studies perspective and document the selected topic from a transportation studies perspective and document the selected topic from a transportation studies perspective and document to the selected topic from a transportation studies perspective and document to the selected topic from a transportation studies perspective and document to the selected topic from a transportation studies perspective and document to the selected topic from a transportation studies perspective and document to the selected topic from a transportation studies perspective and document to the selected topic from a transportation studies perspective and document to the selected topic from a transportation studies perspective and document to the selected topic from a transportation studies perspective and document to the selected topic from a transportation studies perspective and document to the selected
	 comprehensively examine a pre-defined of sen-selected topic from a transportation studies perspective and document of results in accordance with scientific conventions.
Personal Competence	
Social Competence	Students are able to:
	 provide feedback on topical contents and their teaching.
	constructively handle feedback on their own work.
	produce results in group work and document these.
Autonomy	Students are able to:
	assess potential consequences of their future professional activities
	• independently plan working on a pre-defined project topic, acquire the necessary knowledge and use appropriate means f
	its execution.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and	written assignment with presentation during the semester
scale	
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory
	Civil Engineering. Specialisation Coastal Engineering: Elective Compulsory
	Logistics, Infrastructure and Mobility, Specialization Infrastructure and Mobility Elective Computerny
	Logisucs, minascitucure and mobility: specialisation minascitucture and mobility: Elective Compulsory
	Water and Environmental Engineering. Specialisation Environment: Elective Compulsory
	Water and Environmental Engineering: Operationation Citica Computers

Course L1068: Integrated Tr	ansportation Planning
Тур	Project-/problem-based Learning
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Carsten Gertz, Dr. Philine Gaffron, Jacqueline Bianca Maaß
Language	DE
Cycle	WiSe
Content	The course will provide students with an understanding of interdependencies between land-use and transportation. Specific topics
	 include a.o.: interactions between transport and the environment and consequent limitations characteristics of integrated planning complex planning processes interdependencies of location choice and mobility behaviour transport and land-use policies project on current issues in transportation studies
Literature	Kutter, Eckhard (2005) Entwicklung innovativer Verkehrsstrategien für die mobile Gesellschaft. Erich Schmidt Verlag. Berlin. Bracher, Tilman u. a. (Hrsg.) (68. Ergänzung 2013) Handbuch der kommunalen Verkehrsplanung. Herbert Wichmann Verlag. Berlin, Offenbach. (Loseblattsammlung mit kontinuierlichen Ergänzungen)

Module M0963: Steel	and Composite Structures			
Courses				
Title		Тур	Hrs/wk	СР
Steel and Composite Structures (L1	204)	Lecture	2	2
Steel and Composite Structures (L1	.205)	Recitation Section (large)	2	2
Steel Bridges (L1097)		Lecture	2	2
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
Recommended Previous	Basics of steel construction (i.e. Steel Structures I and II, BUBC)			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	After successful completition, students can			
	describe the phenomenon of local buckling			
	explain warping torsion			
	Industrate the behaviour of composite structures			
	 specify the principles in design of composite sttructures 			
	sketch the contructions of steel and composite bridges			
Skills	After successful participation students are able to			
	 check stiffened and unstiffened plated structures 			
	 recognize and verify warping tosion in strucures 			
	 design composite structures 			
	 design bridges and o perform the detailing 			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Compu	lsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elec	tive Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective C	Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Con	npulsory		
	International Management and Engineering: Specialisation II. C	ivil Engineering: Elective Com	oulsory	

Course L1204: Steel and Composite Structures		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Marcus Rutner	
Language	DE	
Cycle	WiSe	
Content	 Local-buckling of plated structures Warping torsion Composite-girders, -columns, -slabs, -bridges Principles in composite constructions Bridge-design and -construction 	
Literature	Petersen, C.: Stahlbau, 4.Auflage 2013, Springer-Vieweg Verlag Minnert, J. Wagenknecht, G.: Verbundbau-Praxis - Berechnung und Konstruktion nach Eurocode 4, 2.Auflage 2013, Bauwerk Beuth Verlag	

Course L1205: Steel and Composite Structures	
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Marcus Rutner
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1097: Steel Bridges	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Jörg Ahlgrimm
Language	DE
Cycle	WiSe
Content	Lecture Contents ,Steel Bridge Construction
	Dring. Jorg Anigrimm
	- From tendering and contracting to completion - the development of a steel bridge
	- Contents of a bridge static - structural details, examples of analysis in detail:
	-> effective width in regard to the longitudinal stiffeners
	-> Bearing point, bearing stiffener
	-> Crossbeam breakthrough, crossbeam reinforcement
	-> Analysis of the Rib-to-Floorbeam (RF) connection (web-tooth of the floorbeam between trapezoidal shaped Ribs)
	- Steel grades, -designation, testing methods and approval certificates
	- Nondestructive weld inspecting
	- Corrosion protection
	- Bridge bearing - types, format, function, dimensioning, installation
	- Expansion Joints
	- Oscillation of bridge hangers and cables - oscillation damper
	- Opening bridges- Detailed reviews to different assembling procedures and - implements
	- Selective damage events
	Requirements: Basic knowledge in the calculation, dimensioning, and construction of structural elements and joints of constructional steelwork
Literature	
	Herbert Schmidt, Ulrich Schulte, Rainer Zwätz, Lothar Bär: Ausführung von Stahlbauten
	Petersen, Christian: Stahlbau, Abschnitt Brückenbau
	 Ahlgrimm, J., Lohrer, I.: Erneuerung der Eisenbahnüberführung in Fulda-Horas über die Fulda, Stahlbau 74 (2005), Heft 2, S. 114

Module M0966: Study	V Work Foundation Engineering
Courses	
Title	Typ Hrs/wk CP
Module Responsible	Dozenten des SD B
Admission Requirements	None
Recommended Previous	Subjects of the Foundation Engineering specialisation.
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students are able to demonstrate their detailed knowledge in the field of geotechnical and foundation engineering. They car exemplify the state of technology and application and discuss critically in the context of actual problems and general conditions of science and society.
	The students can develop solving strategies and approaches for fundamental and practical problems in geotechnical and foundation engineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view points of science and society.
Skills	Scientific work techniques that are used can be described and critically reviewed. The students are able to independently select methods for the project work and to justify this choice. They can explain how these methods relate to the field of work and how the context of application has to be adjusted. General findings and furthe developments may essentially be outlined.
Personal Competence	
Social Competence	The students are able to condense the relevance and the structure of the project work, the work steps and the sub-problems fo the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to their colleagues.
Autonomy	The students are capable of independently planning and documenting the work steps and procedures while considering the giver deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain feedback from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology.
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0
Credit points	6
Course achievement	None
Examination	Study work
Examination duration and	see FSPO
scale	
Assignment for the	Civil Engineering: Specialisation Geotechnical Engineering: Compulsory
Following Curricula	

Courses				
Title	Тур		Hrs/wk	СР
Ergonomics (L0653)	Lecture		2	3
Analysis of Offshore Structures (L18	867) Lecture		1	1
Excellence in International Project I	Delivery (L2387) Integrated Lecture		2	2
Design of Prefabricated Concrete S	tructures (L0596) Lecture		1	1
Design of Prefabricated Concrete S	tructures (L0597) Recitation Section (la	arge)	1	1
Forum I - Geotechnics and Construct	ction Management (L1634) Seminar		1	1
Forum II - Geotechnics and Constru	iction Management (L1635) Seminar		1	1
Geotechnical Engineering Design (I	L2447) Lecture		2	3
Timber Structures (L1151)	Seminar		2	2
Innovative Timber Construction (L2	(666) Lecture		2	3
Glass Structures (L1152)	Lecture		2	2
Glass Structures (L1447)	Recitation Section (Ia	arge)	1	1
Testing and non-destructive examined	nation of concrete members (L2725) Project-/problem-bas	ed Learning	2	2
Special topics of civil engineering 1	.CP (L2378)		1	1
Special topics of civil engineering 2	2 LP (L2379)		2	2
Special topics of civil engineering 3	3 LP (L2380)		3	3
Structural Design (L2789)	Seminar		2	2
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge				
	Students are able to find their way through selected special areas within civil	and structura	al engineering	l.
	Students are able to explain basic models and procedures in selected special	areas of civil	and structura	al engineering.
	 Students are able to interrelate scientific and technical knowledge. 			
Chille				
SKIIIS	 Students are able to apply basic methods in selected areas of civil and structule 	ural engineer	ing.	
		-	-	
Personal Competence				
Social Competence				
Autonomy				
	 Students can chose independently, in which fields they want to deepen their 	r knowledge	and skills thr	rough the election of
	courses.			
Workload in Hours	Depends on choice of courses			
Credit points				
	v			
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory			

Course L0653: Ergonomics	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and	30 min
scale	
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	

Module Manual M.Sc. "Civil Engineering"

Course L1867: Analysis of Of	ifshore Structures
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and	30 min
scale	
Lecturer	Dr. Said Fawad Mohammadi
Language	DE/EN
Cycle	SoSe
Content	Topic 1: Types of Offshore Structures, Fixed and floating structures for Oil & Gas and Offshore Wind industry
	Topic 2: Wave Forces, Morisons equation
	Topic 3: Irregular Seastates, Power spectrum and application of FFT
	Topic 4: Additional Environmental Forces, wind spectra, current forces
	Topic 5: Linear-Time-Invariant Systems, response of an LTI-system in frequency domain
	Topic 6: Tubular Welded Connections, stress concentration factors, weld geometry
	Topic 7: Introduction to Fracture Mechanics, criteria for fracture initiation and crack growth
	Topic 8: Time and Frequency Domain Fatigue Analyses, rainflow counting, application of LTI-systems for frequency domain fatigue
	Topic 9: Offshore Installation and Exam, installation of structures, pile driving, pipe laying techniques
Literature	Chakrabarti, Handbook of Offshore Engineering, 2005
	Sarpkaya, Wave Forces on Offshore Structures, 2010
	Faltinsen, Sea Loads on Ships and Offshore Structures, 1998
	Sorensen, Basic Coastal Engineering, 2006
	Dowling, Mechanical Behavior of Materials, 2007
	Haibach, Betriebsfestigkeit, 2006
	Marshall, Design of Welded Tubular Connections, 1992
	Newland, Random vibrations, spectral and wavelet analysis, 1993

Course L2387: Excellence in International Project Delivery	
Тур	Integrated Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	laut FSPO
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt
scale	
Lecturer	Dr. Jens Huckfeldt
Language	EN
Cycle	SoSe
Content	
Literature	

Course L0596: Design of Pre	fabricated Concrete Structures
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and	60 min
scale	
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	SoSe
Content	 application and advantages and disadvantages of precast concrete structures basics of design - precast element production - construction - tolerances elements of a warehouse design of a beam - joints design of D-regions: half joints, corbels, openings slab types - walls - facades footings: pocket and block foundations joints - connections shear design of the interface between concrete cast at different times unreinforced concrete structures
Literature	 Bachmann H., Steinle A.; Hahn V.: Bauen mit Betonfertigteilen. Betonkalender 2009, Teil I, Verlag Ernst & Sohn, Berlin Bindseil P.: Stahlbetonfertigteile. Werner Verlag, 1998 FIP: FIP Handbuch für Planung und Entwerfen von Fertigteilbauten (siehe Zeitschrift: Beton- und Fertigteiltechnik ab 3/1996) Bergmeister K.: Konstruieren von Fertigteilen. Betonkalender 2005 Teil 2, S. 163-240 Reineck KH.: Modellierung der D-Bereiche von Fertigteilen. Betonkalender 2005 Teil 2, S. 241-296 Graubner CA. et. al.: Bemessung von Fertigteilen nach DIN 1045-1. Betonkalender 2005 Teil 2, S. 297-374 Broschüren der Fachvereinigung Deutscher Betonfertigteilbau e.V. siehe: www.fdb-fertigteilbau.de www.systembauweise.de

Course L0597: Design of Prefabricated Concrete Structures	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and	Siehe korrespondierende Vorlesung
scale	
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1634: Forum I - Geotechnics and Construction Management	
Тур	Seminar
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and	30 min
scale	
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	Lectures about projects and issues with practical and scientific relevance.
Literature	

Course L1635: Forum II - Geotechnics and Construction Management	
Тур	Seminar
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and	30 min
scale	
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	SoSe
Content	Lectures about projects and issues with practical and scientific relevance.
Literature	

Course L2447: Geotechnical	Engineering Design
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and	45 Min.
scale	
Lecturer	Prof. Jürgen Grabe, Dr. Tim Pucker
Language	DE
Cycle	WiSe
Content	The focus of the course is on the design of geotechnical structures. Methods and fundamental approaches for the successful
	processing of geotechnical designs are taught. Theoretical approaches are backed up with examples from everyday work in
	industry. In parallel to the theoretical content, students are given a practical task for a geotechnical design at beginning of the
	course, which will be worked on in small teams. In addition to the application of the already acquired technical knowledge, topics
	like realisation, construction sequence planning, cost calculation, optimisation and evaluation criteria are also part of the course.
	The event will be finished with the presentation of the designs.
Literature	

Course L1151: Timber Structures	
Тур	Seminar
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and	90 min
scale	
Lecturer	Prof. Torsten Faber
Language	DE
Cycle	WiSe
Content	
Literature	

Course L2666: Innovative Timber Construction		
Lecture		
2		
3		
Independent Study Time 62, Study Time in Lecture 28		
Schriftliche Ausarbeitung		
45 Minuten		
Dr. Andreas Meisel		
DE		
WiSe		
- Blass, J.: "Ingenieurholzbau"		
- Schickhofer, G.: "BSPhandbuch: Holz-Massivbauweise in Brettsperrholz"		
- Informationsdienst Holz: div. Merkblätter und Broschüren		
- Wallner-Novak M.: Brettsperrholz Bemessung, Band 1 und 2		
- Gerner M.: "Fachwerk: Entwicklung, Instandsetzung, Neubau"		
- Meisel, A.: "Historische Dachwerke: Beurteilung, realitätsnahe statische Analyse und Instandsetzung"		
- Kempe K.: "Dokumentation Holzschädlinge"		
- Huckfeldt T.: "Hausfäule- und Bauholzpilze"		

Course L1152: Glass Structu	res
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and	
scale	
Lecturer	Marvin Matzik
Language	DE
Cycle	WiSe
Content	Glass structures
	- Introduction of the material glass (production, refinement, material characteristic)
	- design of facades
	- facade types
	- static calculation of glazing
	- static calculation of facades
	- load bearing behavior of glazing (plate or membrane stiffness)
	- vertical / horizontal glazing with safety-related requirements
	- glass structures
	- fire safety of glass facades
	- construction physics of facades and glazing
Literature	

Course L1447: Glass Structures				
Тур	Recitation Section (large)			
Hrs/wk	1			
СР	1			
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14			
Examination Form	Mündliche Prüfung			
Examination duration and				
scale				
Lecturer	Marvin Matzik			
Language	DE			
Cycle	WiSe			
Content	See interlocking course			
Literature	See interlocking course			

Course L2725: Testing and non-destructive examination of concrete members				
Тур	Project-/problem-based Learning			
Hrs/wk	2			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Examination Form	Mündliche Prüfung			
Examination duration and	20 min			
scale				
Lecturer	Dr. Lukas Henze, Dr. Lukas Henze			
Language	DE			
Cycle	SoSe			
Content				
Literature				

Course L2378: Special topics of civil engineering 1CP				
Тур				
Hrs/wk	1			
СР	1			
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14			
Examination Form	laut FSPO			
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt			
scale				
Lecturer	Dozenten des SD B			
Language	DE			
Cycle	WiSe/SoSe			
Content	The course occurs only if required. The content is defined at short notice.			
Literature	Die Literatur wird kurzfristig festgelegt.			

Course L2379: Special topics of civil engineering 2 LP				
Тур				
Hrs/wk	2			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Examination Form	laut FSPO			
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt			
scale				
Lecturer	Dozenten des SD B			
Language	DE			
Cycle	WiSe/SoSe			
Content	The course occurs only if required. The content is defined at short notice.			
Literature	Die Literatur wird kurzfristig festgelegt.			

Course L2380: Special topics of civil engineering 3 LP				
Тур				
Hrs/wk	3			
СР	3			
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Examination Form	laut FSPO			
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt			
scale				
Lecturer	Dozenten des SD B			
Language	DE			
Cycle	WiSe/SoSe			
Content	The course occurs only if required. The content is defined at short notice.			
Literature	Die Literatur wird kurzfristig festgelegt.			

Module Manual M.Sc. "Civil Engineering"

Course L2789: Structural De	sign
Тур	Seminar
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and	20 min
scale	
Lecturer	Dr. Jan Mittelstädt
Language	DE/EN
Cycle	SoSe
Content	
Literature	[1] Structure Systems by Heino Engel, Hantje Cantz, 3rd edition (Feb 2007), ISBN-10: 3775718761
	Form and Force, Designing Efficient, Expressive Structures by Allan, E., Zalewski, W. et al, John Wiley and
	Sons; 1st edition (Sept 2009), ISBN-10: 047017465X
	[2] Peter Rice: An Engineer Imagines, ISBN-10 : 1849944237
	[3] Konrad Wachsmann and the Grapevine Structure by C. Sumi et al., Park Books (Oct 2018), ISBN-10:
	9783038601104
	[4] Manual of Multi-Story Timber Construction by Hermann Kaufmann, Stefan Krotsch, Stefan Winter, DETAIL, (June 2018) JSBN-10: 3955533948
	[5] The Art of Structural Design: A Swiss Legacy by B. Billington. Princeton University Art Museum: First Edition
	edition (Mar 2003), ISBN-10: 0300097867
	[6] Structured Lineages: Learning from Japanese Structural Design by G. Nordenson et al, The Museum of
	Modern Art (Jul 2019), ISBN-10: 1633450562
	[7] The Structure: Works of Mahendra Raj by V. Mehta, R. Mehndiretta, A. Huber, Park Books (Oct 2015),
	ISBN-10: 3038600253

Module M0997: Struc	tural Analysis - Selected Topics						
Courses							
Title		Тур	Hrs/wk	СР			
Plates and Shells (L1199)		Lecture	2	2			
Nonlinear Analysis of Frame Struct	ure (L1200)	Lecture	2	2			
Nonlinear Analysis of Frame Structu	ure (L1201)	Recitation Section (large)	2	2			
Module Responsible	Prof. Uwe Starossek						
Admission Requirements	None						
Recommended Previous	Mechanics I/II, Mathematics I/II, Differential Equations						
Knowledge							
Educational Objectives	After taking part successfully, students have reached	the following learning results					
Professional Competence							
Knowledge	After successful completion of this module, students	can explain selected elements of higher s	structural analys	is.			
Skills							
SKIIIS							
	After successful completion of this module, the stud	lents are able to assess the premises a	nd the applicabi	ility of the presented			
	methods of advanced structural analysis. They are able to use these methods for performing structural analyses.						
Personal Competence							
Social Competence	Students can						
oocial competence							
	 participate in subject-specific and interdiscipling 	ary discussions,					
	 defend their own work results in front of others 	5					
	 promote the scientific development of colleague 	les					
	 Furthermore, they can give and accept profess 	ional constructive criticism					
Autonomy	The students have the opportunity to voluntarily and	independently work homework problems	i.				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84	1					
Credit points	6						
Course achievement	None						
Examination	Written exam						
Examination duration and	135 min						
scale							
Assignment for the	Civil Engineering: Specialisation Structural Engineerir	g: Elective Compulsory					
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory						
-	ivil Engineering: Specialisation Coastal Engineering: Elective Compulsory						

Course L1199: Plates and Sh	ells
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Jürgen Priebe
Language	DE
Cycle	WiSe
Content	Theory of plates loaded in-plane
	 Governing equations (equilibrium, kinematics, constitutive law) Differential equation Airy stress function Plane stress / plane strain Structural behaviour of plates loaded in-plane Theory of plates in bending Governing equations (equilibrium, kinematics, constitutive law) Differential equation Navier solution / Fourier series expansion Approximation procedures Structural behaviour of plates in bending Shell theory Phenomenona of the structural behaviour of shells Membrane and bending theory Equilibrium equations of shells of revolution Stress resultants and deformations of the spherical shell, the half spherical shell, and the cylindrical shell Stability problems (overview)
	Shell buckling
Literature	 Basar, Y.: Krätzig, W.B. (1985): Mechanik der Flächentragwerke. Vieweg-Verlag, Braunschweig, Wiesbaden Girkmann, K. (1963): Flächentragwerke, Springer Verlag, Wien, 1963, unveränderter Nachdruck 1986 Zienkiewicz, O.C. (1977): The Finite Element Method in Enginieering Science. McGraw-Hill, London

Course L1200: Nonlinear Ana	Ilysis of Frame Structure
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	WiSe
Content	-Types of nonlinearity
	-relevance of nonlinear effects on structural analysis
	-comparison and classification of 1 st order theory, 2 nd order theory and 3 rd order theory with regard to the coverage of geometric nonlinearity
	-fundamentals of 2 nd order elasticity theory for frame structures
	-application of 2 nd order elasticity theory using finite elements: common displacement method
	-fundamentals of analytical application of 2 nd order elasticity theory: derivation and solution of differential equation
	-structurally applied methods of analytical application of 2 nd order elasticity theory: common displacement method using analytical stiffness matrix, slope-deflection method for sway and non-sway frame structures, consideration of imperfections
	1 st order plastic hinge theory
Literature	Rothert, H.; Gensichen, V. (1987): Nichtlineare Stabstatik. Springer Verlag, Berlin

Course L1201: Nonlinear Analysis of Frame Structure				
Тур	Recitation Section (large)			
Hrs/wk	2			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Prof. Uwe Starossek			
Language	DE			
Cycle	WiSe			
Content	See interlocking course			
Literature	See interlocking course			

Module M1505: Adap	tation to C	limate Chan	ige in Hydra	aulic Engin	eering (AKWAS)			
Courses								
Title					Тур		Hrs/wk	СР
Adaptation to climate change in hy	draulic engineeri	ng (L2291)			Project-/problem-based L	Learning	4	6
Module Responsible	Prof. Peter Fröl	nle						
Admission Requirements	None							
Recommended Previous Knowledge	HydrologHydromFundamHydrolog	gy, Hydraulic Eng echanic, Hydrauli entals of Coastal gical Systems	ineering ics Engineering, Co	astal- and Flood	Protection			
Educational Objectives	After taking pa	rt successfully, st	tudents have rea	ached the followi	ng learning results			
Professional Competence								
Knowledge Skills Personal Competence	 Climate Insights Impacts Fundam Consequ Measure Assessn Fundam Critical ti Creative Practica method: Conside 	protection and cl into climate chang of climate chang entals of analysis uences of the imp es for climate ada nent, prioritization entals of the anal chinking: analysis e thinking: develo l thinking: inclus s ration of complex	imate adaptation nge and its regio le on the compor s of climate data pact of the climat ptation n and communic lysis of hydrome of processes an pment of adapta sion of restriction c tasks	n inal characteristi nents of the regi te change ration of adaptat eteorological and id relations, asse ation strategies a ins, application	cs - fundamentals, clima onal hydrological cycle ion measures hydrological data essment of needs for acti and adaptation measures of calculation approach	ion s nes, meth	lling / climate	models cal models, planni
Social Competence								
Social competence	WorkingWorkingSelf reflet	in heterogenous with different sci ection	groups ientific / non-scie	entific discipline:	5			
Autonomy	Applicat	ion oriented use	of knowledge an	ıd skills				
	Autonon	nous work on con	nplex tasks					
March 1999 119	ladana da da C	hudu Tim 104 C	turdur Timer d'aut					
workload in Hours	independent S	tudy Time 124, S	tudy Time in Lec	cure 56				
Credit points	Nana							
course achievement	None	- + :						
Examination	written elabora	ation			+!-			
Examination duration and	Preparation of	a written report a	and a presentatio	on of a complex	task.			
Scale	Civil Engineeri	ag Specialization	Coastal Engine	oring, Elective C	ampulson			
Following Curricula	Civil Engineeri	ng. specialisation		ngineering: Elective Cl				
i onowing curricula	Civil Engineeri	ng: Specialisation	Structural Engin	neerina: Flective	Compulsory			
	Civil Engineeri	ng: Specialisation	Water and Traff	fic: Elective Com	pulsory			
	Water and Env	ironmental Engin	eering: Specialis	sation Cities: Ele	ctive Compulsorv			
	Water and Env	ironmental Engin	eering: Specialis	sation Environme	ent: Elective Compulsory	/		
	Water and Env	ironmental Engin	eering: Specialis	sation Water: Ele	ctive Compulsory			

Course L2291: Adaptation to	climate change in hydraulic engineering
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe
Content	 Climate protection and climate adaptation Findings on climate change and its regional characteristics: fundamentals of climate change, climate modelling / climate models Impacts of climate change on the components of the regional hydrological cycle(climate science view) Fundamentals of the analysis of climate data Concequences of the impacts of climate change (ingenieering science view) Measures for climate change adaptation Assessment, prioritization and communication of measures Fundamentals of analysis of hydrometeorological and hydrological data
Literature	Bereitgestellte eLearning Plattform

Module M1725: Scien	tific Working in Computational I	Engineering		
Courses				
Title		Тур	Hrs/wk	СР
Scientific Working in Computationa	I Engineering (L2764)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None			
Recommended Previous	Basic knowledge in scientific writing. String int	erest in topics related to computing in civil engine	ering.	
Knowledge				
Educational Objectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence				
Knowledge	course instructors and in collaboration with ea thinking, being able to accurately plan, impl scientific writing is of particular importance in examination. The paper will be written based presentations, and critical discussions of scien	ch other, the students will also learn to understan lement and analyze scientific projects, such as this course, a scientific paper will be developed, y on a project to be conducted within this course. tific publications are further key activities.	d the comple: prospective r which is a pre Project meet	x process of scientific master theses. Since erequisite for the final ings in small groups,
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Le	ecture 56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	10 pages of work with 15-minute oral presenta	tion		
scale				
Assignment for the	Civil Engineering: Specialisation Water and Tra	ffic: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical	Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engine	eering: Elective Compulsory		
	Civil Engineering: Specialisation Structural Eng	ineering: Elective Compulsory		

Course L2764: Scientific Working in Computational Engineering	
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Kay Smarsly
Language	EN
Cycle	WiSe/SoSe
Content	In the course, a scientific problem of practical relevance will first be defined, taking into account the interests of the students participating in the course. The scientific problem will then systematically be solved within the framework of a comprehensive project. The principles of scientific working will be taught based on the scientific problem defined previously. As an integral part of scientific working, fundamentals of scientific writing will be presented and applied to a scientific paper to be written during the course. Topics related to scientific writing include structuring in scientific writing (structuring the abstract, the introduction, the main part, the summary and conclusions, and the acknowledgments and references) and recommendations on effective scientific writing (principles of composition, use of English in scientific writing, useful tips, creating figures, writing in mathematics, referencing, and formal email correspondence). A final paper and a final presentation will be assembled by the students.
Literature	

Module M1718: Multiphase Flow in Porous Media				
Courses				
Title		Тур	Hrs/wk	СР
Advanced Modeling Techniques for Multiphase Flow in Porous Media (L2738)		Recitation Section (small)	2	2
Fundamentals of Multiphase Flow in Porous Media (L2736)		Lecture	2	2
Fundamentals of Multiphase Flow i	n Porous Media (L2737)	Recitation Section (large)	2	2
Module Responsible	Prof. Nima Shokri			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture	84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Water and Traffic:	Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engin	neering: Elective Compulsory		
	Civil Engineering: Specialisation Geotechnical Engin	neering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic:	Elective Compulsory		
	Environmental Engineering: Specialisation Water: E	ective Compulsory		
	Environmental Engineering: Specialisation Water: E	ective Compulsory		
	Water and Environmental Engineering: Specialisati	on Cities: Elective Compulsory		
	Water and Environmental Engineering: Specialisati	on Cities: Elective Compulsory		
	Water and Environmental Engineering: Specialisati	on Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisati	on Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	on Water: Elective Compulsory		
	Water and Environmental Engineering: Specialisati	on Water: Elective Compulsory		

Course L2738: Advanced Modeling Techniques for Multiphase Flow in Porous Media	
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Nima Shokri
Language	EN
Cycle	SoSe
Content	
Literature	

Course L2736: Fundamentals of Multiphase Flow in Porous Media	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Nima Shokri
Language	EN
Cycle	SoSe
Content	
Literature	

Course L2737: Fundamentals of Multiphase Flow in Porous Media				
Тур	Recitation Section (large)			
Hrs/wk	2			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Hannes Nevermann			
Language	EN			
Cycle	SoSe			
Content	See interlocking course			
Literature	See interlocking course			
Module M1724: Smar	t Monitoring			
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Courses				
Title		Тур	Hrs/wk	СР
Smart Monitoring (L2762)		Integrated Lecture	2	2
Smart Monitoring (L2763)		Recitation Section (small)	2	4
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None			
Recommended Previous	Basic knowledge or interest in object-oriented modeling, pro	gramming, and sensor techno	logies are helpfu	I. Interest in moderr
Knowledge	research and teaching areas, such as Internet of Things, Ind	ustry 4.0 and cyber-physical s	ystems, as well a	as the will to deepen
	skills of scientific working, are required. Basic knowledge in sc	ientific writing and good Englis	h skills.	
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence	The racing part succession, statents have reached the follo			
Knowledge	The students will become familiar with the principles and	practices of smart monitoring	The students w	ill be able to design
Knowiedge	decentralized smart systems to be applied for continuous	(remote) monitoring of syste	ems in the built	and in the natura
	environment. In addition, the students will learn to design an	d to implement intelligent sens	or systems using	state-of-the-art data
	analysis techniques, modern software design concepts, and e	mbedded computing methodolo	ogies. Besides lec	tures, project work is
	also part of this module. In small groups, the students v	vill design smart monitoring s	systems that int	egrate a number of
	"intelligent" sensors to be implemented by the students.	Specific focus will be put on	the application	of machine learning
	techniques. The smart monitoring systems will be mounted of	on real-world (built or natural) s	systems, such as	bridges or slopes, or
	on scaled lab structures for validation purposes. The outcom	e of every group will be docun	nented in a pape	r. All students of this
	module will "automatically" participate with their smart mo	nitoring system in the annual	"Smart Monitori	ng" competition. The
	written papers and oral examinations form the final grades. The	he module will be taught in Eng	lish. Limited enro	ollment.
Skills				
Personal Competence				
Social Competence				
Αυτοποπν				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	10 pages of work with 15-minute oral presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Water and Traffic: Elective Co	ompulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Ele	ective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective	Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Electi	ve Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective	Compulsory		
	Civil Engineering: Specialisation Geotechnical Engineering: Ele	ective Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Election	ve Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Co	ompulsory		
	Environmental Engineering: Specialisation Waste and Energy:	Elective Compulsory		
	Environmental Engineering: Specialisation Biotechnology: Elec	ctive Compulsory		
	Environmental Engineering: Specialisation Water: Elective Cor	mpulsory		
	Environmental Engineering: Specialisation Waste and Energy:	Elective Compulsory		
	Environmental Engineering: Specialisation Biotechnology: Elec	ctive Compulsory		
	Environmental Engineering: Specialisation Water: Elective Cor	mpulsory		
	Water and Environmental Engineering: Specialisation Cities: E	lective Compulsory		
	Water and Environmental Engineering: Specialisation Cities: E	nective Compuisory		
	Water and Environmental Engineering: Specialisation Environmental	ment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Environmental	Elective Compulsory		
	Water and Environmental Engineering: Specialisation Water: E	Elective Compulsory		

Course L2762: Smart Monito	ring
Тур	Integrated Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Kay Smarsly
Language	EN
Cycle	WiSe/SoSe
Content	In this course, principles of smart monitoring will be taught, focusing on modern concepts of data acquisition, data storage, and data analysis. Also, fundamentals of intelligent sensors and embedded computing will be illuminated. Autonomous software and decentralized data processing are further crucial parts of the course, including concepts of the Internet of Things, Industry 4.0 and cyber-physical systems. Furthermore, measuring principles, data acquisition systems, data management and data analysis algorithms will be discussed. Besides the theoretical background, numerous practical examples will be shown to demonstrate how smart monitoring may advantageously be used for assessing the condition of systems in the built or natural environment.
Literature	

Course L2763: Smart Monito	ring
Тур	Recitation Section (small)
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Kay Smarsly
Language	EN
Cycle	WiSe/SoSe
Content	The contents of the exercises are based on the lecture contents. In addition to the exercises, project work will be conducted, which will consume the majority of the workload. As part of the project work, students will design smart monitoring systems that will be tested in the laboratory or in the field. As mentioned in the module description, the students will participate in the "Smart Monitoring" competition, hosted annually by the Institute of Digital and Autonomous Construction. Students are encouraged to contribute their own ideas. The tools required to implement the smart monitoring systems will be taught in the group exercises as well as through external sources, such as video tutorials and literature.
Literature	

Specialization Structural Engineering

Module M0699: Geotechnics III Courses Title Тур Hrs/wk СР Numerical Methods in Geotechnics (L0375) Lecture 3 3 2 2 Advanced Foundation Engineering (L0497) Lecture Advanced Foundation Engineering (L0498) Recitation Section (large) 1 1 Module Responsible Prof. Jürgen Grabe Admission Requirements None **Recommended Previous** Knowledge Educational Objectives After taking part successfully, students have reached the following learning results **Professional Competence** Knowledge Skills Personal Competence Social Competence Autonomy Workload in Hours Independent Study Time 96, Study Time in Lecture 84 **Credit points** 6 Compulsory Bonus Form Description **Course achievement** Yes None Subject theoretical and practical work Examination Written exam Examination duration and 120 min scale Assignment for the Civil Engineering: Specialisation Structural Engineering: Compulsory **Following Curricula** Civil Engineering: Specialisation Geotechnical Engineering: Compulsory Civil Engineering: Specialisation Coastal Engineering: Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory

Course L0375: Numerical Methods in Geotechnics		
Тур	Lecture	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Dr. Hans Mathäus Stanford	
Language	DE	
Cycle	WiSe	
Content	Topics: • numerical simulations • numerical algorithms • finite element method • application of finite element method in geomechanics • constitutive models for soils • contact models for soil structure interaction	
Literature	 selected applications Wriggers P. (2001): Nichtlineare Finite-Elemente-Methoden, Springer Verlag, Berlin Bathe Klaus-Jürgen (2002): Finite-Elemente-Methoden. Springer Verlag, Berlin 	

Course L0497: Advanced Foundation Engineering		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Jürgen Grabe	
Language	DE	
Cycle	WiSe	
Content	 Vertical drains Piles Ground improvement (Deep Compaction, Soil mixing) Vibration driving Jet grouting Slurry wall Deep excavation 	
Literature	 EAK (2002): Empfehlungen für Küstenschutzbauwerke EAU (2004): Empfehlungen des Arbeitsausschusses Uferbauwerke EAB (1988): Empfehlungen des Arbeitskreises Baugruben Grundbau-Taschenbuch, Teil 1-3, (1997), Ernst & Sohn Verlag 	

Course L0498: Advanced Foundation Engineering	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0713: Concr	ete Structures	;				
Courses						
Title				Тур	Hrs/wk	СР
Concrete Structures (L0579)				Seminar	1	1
Structural Concrete Members (L057	77)			Lecture	2	3
Structural Concrete Members (L057	(8)			Recitation Section (large)	2	2
Module Responsible	Prof. Günter Rombac	h				
Admission Requirements	None					
Recommended Previous	Basics of structural a	nalysis, conception a	nd dimensioning of str	uctural concrete		
Knowledge	Madulaa, Dainfanaad	Commente Chrysterres I		LUU Mashanian Luu		
	Modules: Reinforced	Concrete Structures I	+II, Structural Analysis	5 I+II, Mechanics I+II		
Educational Objectives	After taking part suc	cessfully students ha	ve reached the followi	na learnina results		
Professional Competence	, and the second second	costany, statents na				
Knowledge	The students broade	n their skills in struct	ural onginooring ocno	cially in the field of building	s (houses roofs h	alls) They dispose
Knowledge	the knowledge for th	a conception and dec	ian of concrete buildin	as and structural members	that are often used	alis). They dispose
	the knowledge for th	e conception and des	ight of concrete buildin		that are often used	
Skills	The students are able to apply procedures of the conception and dimensioning to to practical problems of structural engineering.					
	They are capable to draft concrete buildings and to design them for general action effects and to plan their detailing and					
	execution. Moreover	, they can make desig	n and construction ske	etches and draw up technic	al descriptions.	
Personal Competence						
Social Competence	The students are abl	e to obtain results of	high quality in teamwo	irk.		
Autonomv	The students are abl	e to carry out comple	x conception and dime	nsioning tasks of structures	s under the guidan	ce of tutors.
		,		5		
Workload in Hours	Independent Study T	ime 110, Study Time	in Lecture 70			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	Yes None	Presentation	Es werden 2	Referate ausgegeben		
Examination	Written exam					
Examination duration and	120 minutes					
scale						
Assignment for the	Civil Engineering: Sp	ecialisation Structural	Engineering: Compuls	sory		
Following Curricula	Civil Engineering: Sp	ecialisation Geotechn	ical Engineering: Elect	ive Compulsory		
	Civil Engineering: Sp	ecialisation Coastal E	ngineering: Elective Co	ompulsory		
	Civil Engineering: Sp	ecialisation Water and	d Traffic: Elective Com	pulsory		
	International Manage	ement and Engineerin	g: Specialisation II. Civ	il Engineering: Elective Cor	npulsory	
		-				

Course L0579: Concrete Structures		
Тур	Seminar	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Günter Rombach	
Language	DE	
Cycle	WiSe	
Content	With help of a project teamwork the subjects of the course "Concrete Structures" is practiced, discussed and presented.	
Literature	- Projektbezogene Unterlagen werden abgegeben.	

Course L0577: Structural Con	ncrete Members
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	WiSe
Content	 skyscrapers: structural elements actions on structrues bracing systems design orf slabs (line and point supported plates and floor slabs) membranes and deep beams folded plates and shells truss models reinforced and prestressed members
Literature	 Vorlesungsunterlagen können im STUDiP heruntergeladen werden Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003 Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012 Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalender 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992 Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin 1973 Schlaich J.; Schäfer K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721ff, Verlag Ernst & Sohn, Berlin, 1998 Dames KH.: Rohbauzeichnungen Bewehrungszeichnungen. Bauverlag, Wiesbaden 1997

Course L0578: Structural Concrete Members	
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0963: Steel	and Composite Structures			
Courses				
Title		Тур	Hrs/wk	СР
Steel and Composite Structures (L1	1204)	Lecture	2	2
Steel and Composite Structures (LI	1205)	Recitation Section (large)	2	2
Steel Bridges (L1097)		Lecture	2	2
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
Recommended Previous	Basics of steel construction (i.e. Steel Structures I and II, BUBC)		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	After successful completition, students can			
	 describe the phonomenon of local buckling 			
	evelsing warping tersion			
	 explain warping torsion illustrate the behaviour of composite structures 			
	Industrate the behaviour of composite structures			
	 specify the principles in design of composite structures 			
	sketch the contructions of steel and composite bridges			
Skills	After successful participation students are able to			
	 check stiffened and unstiffened plated structures 			
	 recognize and verify warping tosion in strucures 			
	design composite structures			
	design bridges and o perform the detailing			
Developed Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Course achievement	None			
Evamination	Written exam			
Examination duration and	180 min			
scale	100 mm			
Accignment for the	Civil Engineering: Specialisation Structural Engineering: Comp	lson		
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Compu	noury		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Electronic Control			
	Civil Engineering: Specialisation Coastal Engineering: Elective (compuisory		
	Civil Engineering: Specialisation Water and Traffic: Elective Cor	npuisory		
	International Management and Engineering: Specialisation II. C	ivii Engineering: Elective Com	ouisory	

Course L1204: Steel and Composite Structures		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Marcus Rutner	
Language	DE	
Cycle	WiSe	
Content	 Local-buckling of plated structures Warping torsion Composite-girders, -columns, -slabs, -bridges Principles in composite constructions Bridge-design and -construction 	
Literature	Petersen, C.: Stahlbau, 4.Auflage 2013, Springer-Vieweg Verlag Minnert, J. Wagenknecht, G.: Verbundbau-Praxis - Berechnung und Konstruktion nach Eurocode 4, 2.Auflage 2013, Bauwerk Beuth Verlag	

Course L1205: Steel and Composite Structures			
Тур	Recitation Section (large)		
Hrs/wk			
CP	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Marcus Rutner		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L1097: Steel Bridges				
Тур	Lecture			
Hrs/wk	2			
СР				
Workload in Hours	ndependent Study Time 32, Study Time in Lecture 28			
Lecturer	Dr. Jörg Ahlgrimm			
Language	DE			
Cycle	WiSe			
Content	Lecture Contents ,Steel Bridge Construction			
	Dring. Jorg Anigrimm			
	- From tendering and contracting to completion - the development of a steel bridge			
	- Contents of a bridge static - structural details, examples of analysis in detail:			
	-> effective width in regard to the longitudinal stiffeners			
	-> Bearing point, bearing stiffener			
	-> Crossbeam breakthrough, crossbeam reinforcement			
	-> Analysis of the Rib-to-Floorbeam (RF) connection (web-tooth of the floorbeam between trapezoidal shaped Ribs)			
	Steel grades, -designation, testing methods and approval certificates			
	Nondestructive weld inspecting			
	Corrosion protection			
	Bridge bearing - types, format, function, dimensioning, installation			
	- Expansion Joints			
	- Oscillation of bridge hangers and cables - oscillation damper			
	- Opening bridges- Detailed reviews to different assembling procedures and - implements			
	- Selective damage events			
	Requirements: Basic knowledge in the calculation, dimensioning, and construction of structural elements and joints of constructional steelwork			
Literature				
	Herbert Schmidt, Ulrich Schulte, Rainer Zwätz, Lothar Bär: Ausführung von Stahlbauten			
	Petersen, Christian: Stahlbau, Abschnitt Brückenbau			
	 Ahlgrimm, J., Lohrer, I.: Erneuerung der Eisenbahnüberführung in Fulda-Horas über die Fulda, Stahlbau 74 (2005), Heft 2, S. 114 			

Module M0511: Electi	icity Generation from Wind and H	Hydro Power			
Courses					
Title		Тур	Hrs/wk	СР	
Sustainability Management (L0007)	Lecture	2	1	
Hydro Power Use (L0013)		Lecture	1	1	
Wind Turbine Plants (L0011)		Lecture	2	3	
Wind Energy Use - Focus Offshore	L0012)	Lecture	1	1	
Module Responsible	Dr. Isabel Höfer				
Admission Requirements	None				
Recommended Previous	Module: Technical Thermodynamics I,				
Knowledge	Module: Technical Thermodynamics II,				
	Module: Fundamentals of Fluid Mechanics				
Educational Objectives	After taking part successfully, students have rea	ched the following learning results			
Professional Competence	······				
Knowledge	By ending this module students can explain in	detail knowledge of wind turbines with	h a particular focus of	f wind energy use in	
nule meage	offshore conditions and can critical comment th	ese aspects in consideration of current	developments. Furthe	rmore, they are able	
	to describe fundamentally the use of water power	er to generate electricity. The students	reproduce and explain	the basic procedure	
	in the implementation of renewable energy proje	ects in countries outside Europe.	-p		
	Through active discussions of various topics w	ithin the seminar of the module, stude	ents improve their un	derstanding and the	
	application of the theoretical background and an	e thus able to transfer what they have le	earned in practice.		
Skills	Students are able to apply the acquired theory	etical foundations on exemplary water	or wind power syster	ns and evaluate and	
	assess technically the resulting relationships in	the context of dimensioning and opera	ition of these energy s	systems. They can in	
	compare critically the special procedure for the	implementation of renewable energy pr	rojects in countries out	side Europe with the	
	in principle applied approach in Europe and can	apply this procedure on exemplary theo	pretical projects.	·	
Personal Competence					
Social Competence	Students can discuss scientific tasks subjet-spec	cificly and multidisciplinary within a sem	ninar.		
Autonomy	Students can independently exploit sources in	the context of the emphasis of the lea	ture material to clear	the contents of the	
	lecture and to acquire the particular knowledge a	about the subject area.			
Workload in Hours	Independent Study Time 06 Study Time in Lect	170 94			
Credit points	6	110 04			
Course achievement	None				
Examination	Written oxom				
Examination	2.5 hours written even I. Proncentation in susta	inchility monogoment			
Examination duration and	2.5 hours whiten exam + Prensentation in susta	mability management			
Assignment for the	Civil Engineering, Engelalisation Structural Engin	acting Elective Compulsory			
Eollowing Curricula	Civil Engineering: Specialisation Structural Engin	an and the compulsory			
Following curricula	Civil Engineering: Specialisation Geotechnical Engineer	ring: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory				
	International Management and Engineering: Specials	cialisation II. Renewable Energy: Elective			
	International Management and Engineering: Specialisation II. Renewable Energy: Elective Compulsory International Management and Engineering: Specialisation II. Energy and Environmental Engineering: Elective Compulsory Product Development: Materials and Production: Specialisation Product Development: Elective Compulsory				
	Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory				
	Product Development, Materials and Production: Specialisation Production: Elective Compulsory				
	Renewable Energies: Core Qualification: Compulsory				
	Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory				
	Theoretical Mechanical Engineering: Technical complementary Course. Elective Compulsory				
	Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory				
	Water and Environmental Engineering: Specialisation Environment: Compulsory				
Water and Environmental Engineering: Specialisation Cities: Elective Compulsory					

Course L0007: Sustainability	Management
Тур	Lecture
Hrs/wk	2
CP	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dr. Anne Rödl
Language	DE
Cycle	WiSe
Content	The lecture sustainability management provide an insight into the various aspects and dimensions of sustainability. This content of the course is based on the foundations of environmental assessment; therefore the previous attendance of the lecture environmental assessment is recommended. Various valuation approaches for assessing environmental, economic and social aspects are presented. Their application and use for a sustainability management's discussion is explained by means of short technology examples and is later comprehensively presented through case examples. • Introduction to the topic of sustainability • Dimensions of sustainability: • ecology • economics • social • Transition from the environmental assessment for sustainability management • Case Studies • Excursion
	Objective: The aim of the course is to learn methods for the assessment of sustainability aspects and apply for sustainability management.
Literature	Engelfried, J. (2011) Nachhaltiges Umweltmanagement. München: Oldenbourg Verlag. 2. Auflage
	Corsten H., Roth S. (Hrsg.) (2011) Nachhaltigkeit - Unternehmerisches Handeln in globaler Verantwortung. Wiesbaden: Gabler Verlag.

Course L0013: Hydro Power	Use				
Тур	Lecture				
Hrs/wk	1				
СР					
Workload in Hours	dependent Study Time 16, Study Time in Lecture 14				
Lecturer	Prof. Stefan Achleitner, Hugo Götsch				
Language	DE				
Cycle	SoSe				
Content	 Introduction, importance of water power in the national and global context Physical basics: Bernoulli's equation, usable height of fall, hydrological measures, loss mechanisms, efficiencies Classification of Hydropower: Flow and Storage hydropower, low and high pressure systems Construction of hydroelectric power plants: description of the individual components and their technical system interaction Structural engineering components; representation of dams, weirs, dams, power houses, computer systems, etc. Energy Technical Components: Illustration of the different types of hydraulic machinery, generators and grid connection Hydropower and the Environment Examples from practice 				
Literature	 Schröder, W.; Euler, G.; Schneider, K.: Grundlagen des Wasserbaus; Werner, Düsseldorf, 1999, 4. Auflage Quaschning, V.: Regenerative Energiesysteme: Technologie - Berechnung - Simulation; Carl Hanser, München, 2011, 7. Auflage Giesecke, J.; Heimerl, S.; Mosony, E.: Wasserkraftanlagen - Planung, Bau und Betrieb; Springer, Berlin, Heidelberg, 2009, 5. Auflage von König, F.; Jehle, C.: Bau von Wasserkraftanlagen - Praxisbezogene Planungsunterlagen; C. F. Müller, Heidelberg, 2005, 4. Auflage Strobl, T.; Zunic, F.: Wasserbau: Aktuelle Grundlagen - Neue Entwicklungen; Springer, Berlin, Heidelberg, 2006 				

Course L0011: Wind Turbine	Plants			
Тур	Lecture			
Hrs/wk				
СР	3			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Lecturer	Dr. Rudolf Zellermann, Dr. Jochen Oexmann			
Language	DE			
Cycle	SoSe			
Content	 Historical development Wind: origins, geographic and temporal distribution, locations Power coefficient, rotor thrust Aerodynamics of the rotor Operating performance Power limitation, partial load, pitch and stall control Plant selection, yield prediction, economy Excursion 			
Literature	Gasch, R., Windkraftanlagen, 4. Auflage, Teubner-Verlag, 2005			

Course L0012: Wind Energy	Use - Focus Offshore
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Martin Skiba
Language	DE
Cycle	SoSe
Content	 Introduction, importance of offshore wind power generation, Specific requirements for offshore engineering Physical fundamentals for utilization of wind energy Design and operation of offshore wind turbines, presentation of different concepts of offshore wind turbines, representation of the individual system components and their system-technical relationships Foundation engineering, offshore site investigation, presentation of different concepts of offshore foundation structures, planning and fabrication of foundation structures Electrical infrastructure of an offshore wind farm, Inner Park cabling, offshore substation, grid connection Installation of offshore wind farms, installation techniques and auxiliary devices, construction logistics Development and planning of offshore wind farms Operation and optimization of offshore wind farms Day excursion
Literature	 Gasch, R.; Twele, J.: Windkraftanlagen - Grundlagen, Entwurf, Planung und Betrieb; Vieweg + Teubner, Stuttgart, 2007, 7. Auflage Molly, J. P.: Windenergie - Theorie, Anwendung, Messung; C. F. Müller, Heidel-berg, 1997, 3. Auflage Hau, E.: Windkraftanalagen; Springer, Berlin, Heidelberg, 2008, 4.Auflage Heier, S.: Windkraftanlagen - Systemauslegung, Integration und Regelung; Vieweg + Teubner, Stuttgart, 2009, 5. Auflage Jarass, L.; Obermair, G.M.; Voigt, W.: Windenergie: Zuverlässige Integration in die Energieversorgung; Springer, Berlin, Heidelberg, 2009, 2. Auflage

Module M1351: Const	ruction Processes			
Courses				
Title		Тур	Hrs/wk	СР
Digital Building (L1908)		Lecture	2	2
Lean Construction (L1910)		Lecture	2	2
System Dynamics (L1909)		Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal I	Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotech	nical Engineering: Elective Compulsory		
-	Civil Engineering: Specialisation Structura	al Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water ar	nd Traffic: Elective Compulsory		

Course L1908: Digital Building		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Katja Maaser	
Language	DE	
Cycle	SoSe	
Content		
Literature		

Course L1910: Lean Construction		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Theo Herzog	
Language	DE	
Cycle	SoSe	
Content		
Literature		

Course L1909: System Dynamics			
Тур	Lecture		
Hrs/wk			
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Dr. Markus Salge		
Language	DE		
Cycle	SoSe		
Content			
Literature			

Module M0723: Desig	n of Prestressed Structures	and Concrete Bridges		
Courses				
Title		Тур	Hrs/wk	СР
Design of Prestressed Structures a	nd Concreet Bridges (L0603)	Lecture	3	4
Design of Prestressed Structures a	nd Concreet Bridges (L0604)	Recitation Section (large)	2	2
Module Responsible	Prof. Günter Rombach			
Admission Requirements	None			
Recommended Previous	Detailed knowledge on the design of cond	crete structures.		
Knowledge	Modules: Reinforced Concrete Structures I+II, Structural Analysis I+II, Mechanics I+II, Concrete Structures			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	The students know the main bridge type	es, their applications and the various loads. The	, can explain the b	asic design methods
	They can explain the design of a prestressed bridge.			
Skills	The students are able to design reinforced or prestressed concrete bridges.			
Personal Competence				
Social Competence	The students can design in teamwork a re	eal concrete bridge.		
Autonomy	The students are able to design a prestressed concrete bridge and discuss the problems and results with other students.			
Workload in Hours	Independent Study Time 110, Study Time	e in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 minutes			
scale				
Assignment for the	Civil Engineering: Specialisation Structure	al Engineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechr	nical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal E	Engineering: Elective Compulsory		
	International Management and Engineering	ng: Specialisation II. Civil Engineering: Elective Co	ompulsory	

Course L0603: Design of Pres	stressed Structures and Concreet Bridges
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	SoSe
Content	prestressed structures
	 basis of prestressed structures, field of application differences between reinforced and prestressed concrete structures history of prestressing construction materials: concrete, tendons, ducts, anchorage systems construction: prestressing methods prestressing forces and member forces (friction, elongation) tendon layout time dependant prestressing losses design of prestressed structures design of anchorage region non-bonded prestressing prestressed flat slabs
	Concrete bridges history of bridges design of bridges loads on bridges loads on bridges member forces for slab, T-beam, hollow box, frame and arch bridges precast bridges - precast segmental bridges bearings abutments, columns construction methods damages - checking of bridges
Literature	 Vorlesungsumdruckim STUDiP Rombach, G. (2003): Spannbetonbau. Ernst & Sohn, Berlin Wicke, M. (2002): Anwendung des Spannbetons. Betonkalender 2002, Teil II, S. 113-180, Verlag Ernst & Sohn, Berlin Leonhardt, F. (1980): Vorlesungen über Massivbau. Teil 5: Spannbeton. Berlin Mehlhorn, G. (2007): Handbuch Brücken, Springer Verlag Schäfer, H.; Kaufeld, K. (1997): Massivbrücken. Betonkalender Teil II, S. 443ff, Ernst & Sohn, Berlin Menn, Ch. (1986): Stahlbetonbrücken. Springer Verlag, Wien

Course L0604: Design of Prestressed Structures and Concreet Bridges		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Günter Rombach	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0807: Bound	dary Element I	Methods				
Courses						
Title				Түр	Hrs/wk	СР
Boundary Element Methods (L0523	3)			Lecture	2	3
Boundary Element Methods (L0524	1)			Recitation Section (large)	2	3
Module Responsible	Prof. Otto von Estorf	f				
Admission Requirements	None					
Recommended Previous	Mechanics I (Statics,	Mechanics of Ma	aterials) and Mecl	nanics II (Hydrostatics, Kinematics, E	Dynamics)	
Knowledge	Mathematics I, II, III	(in particular diff	erential equation	5)		
Educational Objectives	After taking part suc	cessfully, studer	nts have reached	the following learning results		
Professional Competence						
- Knowledge	The students posses	s an in-depth ki	nowledge regardi	ng the derivation of the boundary e	element method and	d are able to give an
5	overview of the theo	retical and meth	odical basis of th	e method.		5
Skills	The students are	capable to han	idle engineering	problems by formulating suitable	e boundary elemei	nts, assembling the
	corresponding syste	m matrices, and	solving the result	ing system of equations.		
Personal Competence						
	Ctudente con work ir		a coocific problem	es te arrive at joint colutions		
Social competence	Students can work in	i sman groups of	i specific problem	is to arrive at joint solutions.		
Autonomy	The students are ab	le to independe	ntly solve challer	ging computational problems and c	develop own bounda	ary element routines.
	Problems can be ide	ntified and the re	esults are criticall	y scrutinized.		
Workload in Hours	Independent Study 1	ime 124, Study	Time in Lecture 5	6		
Credit points	6					
Course achievement	No 20 %	Midterm	De	scription		
Examination	Written exam	Hatern				
Examination duration and	90 min					
	50 11111					
Scale	Civil Frankranska v Cr	a sialiaatian Chur	atural Espisia a site			
Assignment for the	Civil Engineering: Sp	ecialisation Stru	ctural Engineering	g: Elective Compulsory		
Following Curricula	Civil Engineering: Sp	ecialisation Geo	technical Enginee	ring: Elective Compulsory		
	Civil Engineering: Sp	eclalisation Coas	stal Engineering:	Elective Compulsory		
	Mechanical Engineer	ing and Manage	ment: Specializet	on Product Development and Produc	ction: Elective Com	ulcony
	Mechanical Engineer		Design: Elective		ction: Elective Comp	Juisory
	Product Development	ansation System	Production: Coro	Qualification: Elective Compulsory		
	Technomothomotics	· Specialization	I Engineering Co			
	Technomothomotics		II. Engineering SC			
	Theoretical Machani		Tochnical Community SC	montany Courses Floating Committee		
	Theoretical Mechani	cal Engineering:	Specialization Cir	amentary Course: Elective Compulso	ulsony	
	meorecical Mechani	car Engineering:	Specialisation SI	manon recinology: Elective Compl	aisol y	

Course L0523: Boundary Eler	ment Methods
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Otto von Estorff
Language	EN
Cycle	SoSe
Content	- Boundary value problems
	- Integral equations
	- Fundamental Solutions
	- Element formulations
	- Numerical integration
	- Solving systems of equations (statics, dynamics)
	- Special BEM formulations
	- Coupling of FEM and BEM
	- Hands-on Sessions (programming of BE routines)
	- Applications
Literature	Gaul, L.; Fiedler, Ch. (1997): Methode der Randelemente in Statik und Dynamik. Vieweg, Braunschweig, Wiesbaden
	Bathe, KJ. (2000): Finite-Elemente-Methoden. Springer Verlag, Berlin

Course L0524: Boundary Element Methods		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Otto von Estorff	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0756: Soil M	lechanics and -Dynamics		
Courses			
Titla		Тур	
Soil Mechanics - Selected Topics (L	0374)	אני Lecture	2 2
Soil Dynamics (L0452)		Lecture	3 2
Experimental Researches in Geotec	chnics (L0706)	Practical Course	1 2
Module Responsible	Prof. Jürgen Grabe		
Admission Requirements	None		
Recommended Previous	modules: Mathematics I-III, Mechanics I-II, 0	Geotechnics I	
Knowledge	courses: Soil laboratory course, (Applied st	ructural dynamics)	
Educational Objectives	After taking part successfully, students have	ve reached the following learning results	
Professional Competence			
Knowledge	After the successful completion of the mod	ule the students should be able to:	
	- to derive and to apply the basic equ	ation of a simple mass oscillator	
	 to understand the wave propagation 	ation of a simple mass oscillator,	etect the relevant narameters
	 to know the essential laboratory and 	I field tests to determine soil dynamic characte	eristics and to evaluate them.
	 to design machine foundations to dy 	mamic load,	
	 to measure shocks to perform vibration forecast, 		
	 to evaluate shocks in term to their effect on people and buildings, 		
	 to evaluate possibilities of isolation, 		
	• to understand mechanisms that cause earthquakes and evaluate earthquake in term of their magnitude and intensity,		
	 to know methods to determine axial pile capacity, integrity and the dynamic bedding modulus, 		
	 to know the mechanisms that lead t mathematically, 	to a deformation accumulation due to cyclic lo	ading and to estimate these deformatio
	 to distinguish the area of application 	n of the method of elastodynamics and plastod	lynamics,
	 to detect the undrained shear strend 	ath as a function of a number of state variable	s.
	 to capture the visous behaviour of c 	cohesive soils and to consider the effects of cr	eep and rate-dependent shear strength
	calculations,		
	 to consider the impact of the partly 	saturated of a seepage and shear strength.	
Skille			
Personal Competence			
Social Competence			
Autonomy			
Workload in Hours	Independent Study Time 96. Study Time in	Lecture 84	
Credit points	6		
Course achievement	Compulsory Bonus Form	Description	
	Yes 15 % Subject theoretic	al and	
	practical work		
Examination	Written exam		
Examination duration and	150 min		
scale			
Assignment for the	Civil Engineering: Specialisation Structural	Engineering: Elective Compulsory	
Following Curricula	Civil Engineering: Specialisation Geotechni	cal Engineering: Compulsory	
	Civil Engineering: Specialisation Coastal En	aineerina: Elective Compulsory	

Course L0374: Soil Mechanics - Selected Topics		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Hans Mathäus Stanford	
Language	DE	
Cycle	SoSe	
Content	selected topis:	
	- continuum mechanis	
	- constitutive modelling	
	- time and rate dependend material behavior of soils	
	- cyclic loading	
	- undrained conditions	
Literature	Kolymbas D. (2007): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. Springer Verlag	

Course L0452: Soil Dynamics	3
Тур	Lecture
Hrs/wk	3
СР	2
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42
Lecturer	Alexander Chmelnizkij
Language	DE
Cycle	SoSe
Content	• mass-spring-damper systems,
	• wave propagation in soils,
	• dynamic soil parameters,
	Determination of dynamic soil parameters,
	• machine foundations,
	• in-situ measurement of ground motion, ground motion prediction, evaluation of ground motion,
	• ground motion shielding,
	• introduction into earthquake engineering,
	• dynamic pile tests,
	• cyclic accumulation,
	• plastodynamics
Literature	 Das B.M.: Fundamentals of Soil Dynamics, Elsevier Empfehlungen des Arbeitskreises Baugrunddynamik. Hrsg. Deutsche Gesellschaft für Geotechnik (DGGT) Haupt W.: Bodendynamik. Vieweg und Teubner Meskouris K. und Hinzen KG.: Bauwerke und Erdbeben. Vieweg Verlag Studer J.A., Koller M.G. und Laue J.: Bodendynamik, Springer Verlag

Course L0706: Experimental	Researches in Geotechnics
Тур	Practical Course
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Dr. Marius Milatz
Language	DE
Cycle	SoSe
Content	The students are supposed to:
	 become acquainted with geotechnical model tests, field tests and laboratory tests as well as corresponding measurement techniques. These compromise amongst others inclinometer measurements and geophone measurements as well as high-grade laboratory tests on the stress-strain relationship of soil specimens, e. g. triaxial tests, simple shear tests and resonant column tests. gain insight into current soil mechanical research. plan, coordinate, perform and evaluate soil mechanical tests in a team. discuss, reflect, review and present the obtained results in a group. An important learning target is the introduction to scientific work for students who plan a scientific career, and for those who will work in practice with the responsibility to order corresponding tests and evaluate the results. The practical laboratory work is based on annualy changing problems, which are however related to the experience and results of the preceding year's course group.
Literature	- Grabe, J. (2004): Bodenmechanik und Grundbau, Band 3 der Veröffentlichungsreihe des Instituts für Geotechnik und Baubetrieb, Technische Universität Hamburg-Harburg.
	- Kolymbas, D. (2007): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. 2., korrigierte und ergänzte Auflage, Springer Verlag.
	 Normen zu geotechnischen Versuchsgeräten und Versuchsverfahren: DIN 18135:2012-04: Baugrund, Untersuchung von Bodenproben - Eindimensionaler Kompressionsversuch, Deutsches Institut für Normung, e. V.
	Bestimmung der Scherfestigkeit - Teil 2: Triaxialversuch, Deutsches Institut für Normung e. V.

Module M0827: Mode	ling in Water Management				
Courses					
Title		Typ	Hrs/wk	CP	
Groundwater Modeling using Modfl	pw (L0543)	Lecture	1	1	
Groundwater Modeling using Modilow (L0545) Groundwater Modeling using Modflow (L0544)		Recitation Section (small)	2	2	
Modeling of Water Supply and Sew	er Network (L0875)	Project-/problem-based Learning	2	3	
Module Responsible	Dr. Klaus Johannsen				
Admission Requirements	None				
Recommended Previous	Groundwater				
Knowledge	a groupdwater budraulics and transport of su	hetaneae			
	groundwater hydraulics and transport of substances				
	Pipe Systems				
	Knowledge on urban water infrastructure	s, in particular drinking water systemsand u	ırban draina	ge systems including	
	special structures				
	 Hydraulics of drinking water supply system 	s and sewer systems			
	 Basic knowledge on water management 				
Educational Objectives	After taking part successfully, students have reac	hed the following learning results			
Professional Competence					
Knowledge	The students are able to describe the modelling o	f groundwater flow and transport as well as urb	oan water infr	astructures. They car	
	carry out systems analyses and can detect techn	ical and conceptual weak points within the sys	tems in case	studies. Besides they	
	are able to analyse interdependencies of hydrauli	c and toxic phenomena in soil and water.			
Skills	The students are able to construct and apply sci	entific groundwater models indipendently. The	v can work (on different scenarios	
	and can compare or assess different solutions for existing problems by application of selected software products. The students a				
	able to use different software solutions (e.g. EPAN	IET, EPA-SWMM).			
Demonstal Commentance					
Personal Competence	Mind all the constitute la				
Social Competence	wird nicht vermitteit.				
Autonomy	Wird nicht vermittelt.				
Workload in Hours	Independent Study Time 110, Study Time in Lectu	ire 70			
Credit points	6				
Course achievement	None				
Examination	Qral exam				
Examination duration and	20 min				
scale					
Assignment for the	Civil Engineering: Specialisation Structural Engine	ering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Eng	ineering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineeri	ing: Elective Compulsory			
	Civil Engineering: Specialisation Water and Traffic	: Elective Compulsory			
	Water and Environmental Engineering: Specialisat	tion Water: Compulsory			
	Water and Environmental Engineering: Specialisat	tion Environment: Elective Compulsory			
	Water and Environmental Engineering: Specialisat	tion Cities: Elective Compulsory			

Course L0543: Groundwater	Modeling using Modflow
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Sonja Götz
Language	DE/EN
Cycle	SoSe
Content	Introduction and application of the groundwater model MODFLOW (PMWIN); theoretical backround of the modell, students do work
	with the model PMWIN for practical case studies.
Literature	MODFLOW-Handbuch
	Chiang, Wen Hsien: PMWIN

Course L0544: Groundwater Modeling using Modflow		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Sonja Götz	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0875: Modeling of Water Supply and Sewer Network		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Dr. Klaus Johannsen, Weitere Mitarbeiter	
Language	DE	
Cycle	SoSe	
Content		
Literature	Mutschmann/Stimmelmayr: Taschenbuch der Wasserversorgung, 16. Auflage. Springer Vieweg - Verlag. Wiesbaden 2014.	

Module M0828: Urban	n Environmental Management			
Courses				
Title	Тур		Hrs/wk	СР
Noise Protection (L1109)	Lecture		2	2
Urban Infrastructures (L0874)	Project-/problem-base	ed Learning	2	4
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
Recommended Previous	Knowledge on Urban planning			
Knowledge	Knowledge on measures for climate protection			
	General knowledge of scientific writing/working			
Educational Objectives	After taking part successfully, students have reached the following learning results			
	Students can describe urban development corriders as well as surrent and future urb	an onviron	mental problem	ms They are able t
Kilowiedge	explain the causes of environmental problems (like noise)		nenitai hioniei	ns. mey dre dole t
	Students can specify applications for various technical innovations and explain why t	hese contril	hute to the im	provement of urba
	life. They can, for example, derive and discuss measures for effective noise abatemer	nt.		
Skills	Students are able to develop specific solutions for correcting existing or future	ire environ	ment-related	problems of urba
	development. They can define a range of conceptual and technical solutions for envir	onmental p	roblems for di	fferent developmen
	paths. To solve specific urban environmental problems they can select technical in	novations a	nd integrate t	them into the urbai
Demonal Commentance	context.			
	The students can work together in international groups			
Social Competence	The students can work together in international groups.			
Autonomy	Students are able to organize their work flow to prepare themselves for presentatio	ns and cont	ributions to th	ne discussions. The
	can acquire appropriate knowledge by making enquiries independently.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Written Report plus oral Presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory			
	Environmental Engineering: Core Qualification: Elective Compulsory	<i></i> -		
	Joint European Master in Environmental Studies - Cities and Sustainability: Core Quali	tication: Cor	mpulsory	
	Logistics, intrastructure and Mobility: Specialisation Infrastructure and Mobility: Electi	ve Compuls	ory	
	water and Environmental Engineering: Specialisation Environment: Elective Compuls	ory		
	water and Environmental Engineering: Specialisation Cities: Compulsory			

Course L1109: Noise Protection		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Martin Jäschke	
Language	EN	
Cycle	SoSe	
Content		
Literature	1) Müller & Möser (2013): Handbook of Engineering Acoustics (also available in German)	
	2) WHO (1999): Guidelines for Community Noise	
	3) Environmental Noise Directive 2002/49/EG	
	4) ISO 9613-2 (1996): Acoustics, Attenuation of sound during propagation outdoors, Part 2: General method of calculation	

Course L0874: Urban Infrastructures	
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Dr. Dorothea Rechtenbach
Language	EN
Cycle	SoSe
Content	Problem Based Learning
	 Main topics are: Central vs. Decentral Wastewater Treatment. Compaction of Cities. Car Free Cities. Multifunctional Places in Cities. The Sustainability of Freight Transport in Cities.
Literature	Depends on chosen topic.

Module M0859: Coastal Hydraulic Engineering II				
Courses				
Title Typ Hrs/wk C		СР		
Coastal- and Flood Protection (L080	(8)	Lecture	2	3
Coastal- and Flood Protection (L141	5)	Project-/problem-based Learning	1	1
Maintennance and Defence of Floor	d Protection Structures (L1411)	Lecture	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Coastal Engineering I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students have the capability to define and expl	ain in detail the important aspects of erosic	on protection	and flood protection
	and are able to apply the aspects to practical coa	stal protection problems. They are able to	design and	dimension important
	coastal protection measures from the functional and	from the constructional point of view.		
e			<i>.</i> .	
Skills	The students are able to select design approaches	for the functional and constructional desig	in of erosion	and flood protection
	measures and apply these approaches to practical de	esign tasks.		
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge in applied problems such as the functional and constructive design of			
	coastal and flood protection structures. Additionaly,	they will be able to work in team with engine	ers of other d	lisciplines.
Autonomy	The students will be able to independently extend th	eir knowledge and apply it to new problems.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 130 min. The e	examination includes tasks with respect to	the general ι	understanding of the
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engine	ering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering	: Compulsory		
L				

Course L0808: Coastal- and Flood Protection		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Peter Fröhle	
Language	DE	
Cycle	SoSe	
Content	Protection of sandy coasts	
	Codiment transport	
	Technical solution for the protection of sandy coasts	
	Construction in direction of the coast	
	Constructions perpendicular to the coast	
	Other Concepst	
	Calculation approaches and numerical models	
	Flood Protection	
	Classification of constructions / measures	
	• Dikes	
	• Dunes	
	Foreland - constructions	
	Flood-Protection Walls	
	Drainage of the hinterland	
Literature	Vorlesungsumdruck	
	Coastal Engineering Manual CEM	

Course L1415: Coastal- and Flood Protection	
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1411: Maintennance and Defence of Flood Protection Structures	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Olaf Müller
Language	DE
Cycle	SoSe
Content	 Dike protection Maintennance of flood protection measures
Literature	Vorlesungsumdruck

Module M0860: Harbo	our Engineering and Harbour Planning			
Courses				
Title Harbour Engineering (L0809) Harbour Engineering (L1414) Port Planning and Port Construction	(10378)	Typ Lecture Project-/problem-based Learning Lecture	Hrs/wk 2 1 2	CP 2 2 2
Module Responsible	Prof. Peter Fröhle	Locale	-	-
Admission Requirements	None			
Recommended Previous	Basics of coastal engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
Knowledge	The students are able to define in details and to choose	e design approaches for the functional d	esign of a po	rt and apply them to
	design tasks. They can design the fundamental element	s of a port.		
Skills	The students are able to select and apply appropriate approaches for the functional design of ports.			
Personal Competence				
Social Competence	The students are able to deploy their gained knowledg	e in applied problems such as the funct	ional design	of ports. Additionaly,
	they will be able to work in team with engineers of other	disciplines.		
Autonomy	The students will be able to independently extend their l	knowledge and apply it to new problems.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 150 min. The exam	nination includes tasks with respect to	the general u	understanding of the
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Structural Engineering:	Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering	ig: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Co	mpulsory		
	Civil Engineering: Specialisation Water and Traffic: Elect	ve Compulsory		
	International Management and Engineering: Specialisation	on II. Civil Engineering: Elective Compuls	ory	
	Theoretical Mechanical Engineering: Technical Complem	entary Course: Elective Compulsory		

Course L0809: Harbour Engineering		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Peter Fröhle	
Language	DE	
Cycle	SoSe	
Content	 Fundamentals of harbor engineering Maritime transportation and waterways engineering Ships Elements of harbors Harbor approaches and water-side harbor areas Terminal design and handling of cargo Quay-walls and piers Equipment of harbors Sluices and other special constructions Connection to inland transportation / inland waterway transportation Protection of harbors Breakwaters and Jetties Wave protection of harbors Fishery and other small harbors 	
Literature	Brinkmann, B.: Seehäfen, Springer 2005	

Course L1414: Harbour Engineering	
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0378: Port Planning and Port Construction	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Frank Feindt
Language	DE
Cycle	SoSe
Content	 Planning and implementation of major projects Market analysis and traffic relations Planning process and plan Port planning in urban neighborhood Development of the logistics center "Port of Hamburg" in the metropolis Quays and waterfront structure Special planning Law Harbor - securing of a flexible use of the port Dimensioning of quays Flood protection structures Port of Hamburg - Infrastructure and development Preparation of areas Scour formation in front of shore structures
Literature	Vorlesungsumdruck, s. www.tu-harburg.de/gbt
Literature	 Flood protection structures Port of Hamburg - Infrastructure and development Preparation of areas Scour formation in front of shore structures Vorlesungsumdruck, s. www.tu-harburg.de/gbt

Courses				
Title		Тур	Hrs/wk	СР
Hydraulic Models (L0813)		Project-/problem-based Learning	1	1
Modelling of Waves (L0812)		Project-/problem-based Learning	1	1
Modelling of Flow in Rivers and Estuaries	(L0810)	Lecture	3	4
Module Responsible Prof.	Peter Fröhle			
Admission Requirements None	2			
Recommended Previous Coas	tal Hydraulic Engineering I			
Knowledge				
Educational Objectives After	r taking part successfully, students have re	ached the following learning results		
Professional Competence				
Knowledge Stud	Students are able to define in detail the basic processes that are related to the modelling of flows in hydraulic engineering.			
Besid	Besides, they can describe the basic aspects of numerical modelling and actual numerical models for the simulation of flows a			
wave	waves.			
<i>Skills</i> Stud	Students are able to apply hydrodynamic-numerical models to practical hydraulic engineering tasks.			
Personal Competence				
Social Competence The	The students are able to deploy their gained knowledge in simple applied problems. Additionaly, they will be able to work in team			
, with	others.	5 1 11 1 5		
Autonomy The s	students will be able to independently exte	end their knowledge and apply it to new problems		
Workload in Hours Indep	pendent Study Time 110, Study Time in Le	cture 70		
Credit points 6				
Course achievement None	2			
Examination Writt	ten exam			
Examination duration and The	duration of the examination is 3 hours.	The examination includes tasks with respect to	the general ι	understanding of the
scale lectu	ire contents and calculations tasks.			
Assignment for the Civil	Engineering: Specialisation Structural Eng	ineering: Elective Compulsory		
Following Curricula Civil	Engineering: Specialisation Geotechnical E	Engineering: Elective Compulsory		
Civil	Engineering: Specialisation Coastal Engine	eering: Elective Compulsory		

Course L0813: Hydraulic Models		
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Peter Fröhle	
Language	DE/EN	
Cycle	SoSe	
Content	 Fundamentals of hydraulic models Model laws Pi theorem of Buckingham Practical examples of hydraulic models 	
Literature	Strobl, Zunic: Wasserbau, Kap. 11 Hydraulische Modelle, Springer	

Course L0812: Modelling of V	Naves
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE/EN
Cycle	SoSe
Content	 Waves, interactions with shallow water and constructions Wave theories Sea state and surges Development of waves Wave spectra Modelling of Waves / phase averaged and phase resolved models Application of a phase averaged model for wave prediction (SWAN) Application of phase resolved wave models (Mike)
Literature	Vorlesungsumdruck

Course L0810: Modelling of I	Flow in Rivers and Estuaries
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Dr. Edgar Nehlsen, Prof. Peter Fröhle
Language	DE/EN
Cycle	SoSe
Content	Basics of numerial models / application of models
	 classification of models model concept modelling 1D Working Equation Mathematical description of physical processes Equation of motions conservation of mass conservation of momentum Initial conditions and boundary conditions Numerical Methods Time step procedure Finite differences Finite volumes
Literature	Vorlesungsskript

Module M0874: Waste	ewater Systems				
Courses					
Title	-	Тур	Hrs/wk	СР	
Wastewater Systems - Collection, T	Freatment and Reuse (L0934)	Lecture	2	2	
Wastewater Systems - Collection, T	Treatment and Reuse (L0943)	Recitation Section (large)	1	1	
Advanced Wastewater Treatment (L0357)	Lecture	2	2	
Advanced Wastewater Treatment (L0358)	Recitation Section (large)	1	1	
Module Responsible	Prof. Ralf Otterpohl				
Admission Requirements	None				
Recommended Previous	Knowledge of wastewater management and	d the key processes involved in wastewater tre	atment.		
Knowledge					
Educational Objectives	After taking part successfully, students hav	e reached the following learning results			
Professional Competence					
Knowledge	Students are able to outline key areas of the	ne full range of treatment systems in waste wa	iter management, a	as well as their mutual	
	dependence for sustainable water protection	on. They can describe relevant economic, envir	onmental and socia	l factors.	
Skille	Students are able to pre-design and expla	in the available wastewater treatment proces	ses and the scone	of their application in	
SKIIIS	municipal and for some industrial treatmon	t plants	ses and the scope	or their application in	
	indificipal and for some industrial treatment	t plants.			
Personal Competence					
Social Competence	Social skills are not targeted in this module.				
4	Chudente era in a nacitiza to work on a	which and to annexica their work flow index			
Autonomy	Students are in a position to work on a s	ubject and to organize their work flow indep	endently. They can	also present on this	
	subject.				
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	120 min				
scale					
Assignment for the	Civil Engineering: Specialisation Structural	Engineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnic	cal Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal En	gineering: Elective Compulsory			
	Civil Engineering: Specialisation Water and	Traffic: Compulsory			
	Bioprocess Engineering: Specialisation A - C	General Bioprocess Engineering: Elective Comp	oulsory		
	Energy and Environmental Engineering: Spe	ecialisation Environmental Engineering: Electiv	e Compulsory		
	Environmental Engineering: Specialisation Water: Elective Compulsory				
	International Management and Engineering	: Specialisation II. Energy and Environmental E	ingineering: Elective	e Compulsory	
	International Management and Engineering	: Specialisation II. Process Engineering and Bio	technology: Electiv	e Compulsory	
	Process Engineering: Specialisation Environ	mental Process Engineering: Elective Compuls	ory		
	Process Engineering: Specialisation Process Engineering: Elective Compulsory				
	Water and Environmental Engineering: Specialisation Water: Compulsory				
	Water and Environmental Engineering: Specialisation Environment: Elective Compulsory				
	Water and Environmental Engineering: Specialisation Cities: Compulsory				

Course L0934: Wastewater S	ystems - Collection, Treatment and Reuse
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	SoSe
Content	•Understanding the global situation with water and wastewater
	•Regional planning and decentralised systems
	•Overview on innovative approaches
	•In depth knowledge on advanced wastewater treatment options for different situations, for end-of-pipe and reuse
	•Mathematical Modelling of Nitrogen Removal
	•Exercises with calculations and design
Literature	Henze, Mogens:
	Wastewater Treatment: Biological and Chemical Processes, Springer 2002, 430 pages
	George Tchobanoglous Franklin I. Burton, H. David Stensel
	Wastewater Engineering: Treatment and Reuse. Metcalf & Eddy
	McGraw-Hill, 2004 - 1819 pages

Course L0943: Wastewater Systems - Collection, Treatment and Reuse		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Ralf Otterpohl	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0357: Advanced Wa	stewater Treatment			
Тур	Lecture			
Hrs/wk	2			
CP	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Dr. Joachim Behrendt			
Language	EN			
Cycle	SoSe			
Content	Survey on advanced wastewater treatment			
	reuse of reclaimed municipal wastewater			
	Precipitation			
	Flocculation Depth filtration Membrane Processes			
	Activated carbon adsorption			
	Ozonation			
	"Advanced Oxidation Processes"			
	Disinfection			
Literature	Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003			
	Wassertechnologie, H.H. Hahn, Springer-Verlag, Berlin 1987			
	Membranverfahren: Grundlagen der Modul- und Anlagenauslegung, T. Melin und R. Rautenbach, Springer-Verlag, Berlin 2007			
	Trinkwasserdesinfektion: Grundlagen, Verfahren, Anlagen, Geräte, Mikrobiologie, Chlorung, Ozonung, UV-Bestrahlung, Membranfiltration, Qualitätssicherung, W. Roeske, Oldenbourg-Verlag, München 2006			
	Organische Problemstoffe in Abwässern, H. Gulyas, GFEU, Hamburg 2003			

Course L0358: Advanced Wa	stewater Treatment
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Joachim Behrendt
Language	EN
Cycle	SoSe
Content	Aggregate organic compounds (sum parameters)
	Industrial wastewater
	Processes for industrial wastewater treatment
	Precipitation
	Flocculation
	Activated carbon adsorption
	Recalcitrant organic compounds
Literature	Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003
	Wassertechnologie, H.H. Hahn, Springer-Verlag, Berlin 1987
	Membranverfahren: Grundlagen der Modul- und Anlagenauslegung, T. Melin und R. Rautenbach, Springer-Verlag, Berlin 2007
	Trinkwasserdesinfektion: Grundlagen, Verfahren, Anlagen, Geräte, Mikrobiologie, Chlorung, Ozonung, UV-Bestrahlung,
	Membranfiltration, Qualitätssicherung, W. Roeske, Oldenbourg-Verlag, München 2006
	Organische Problemstoffe in Abwässern, H. Gulyas, GFEU, Hamburg 2003

Module M0922: City F	Planning		
Courses			
Title	Тур	Hrs/wk	СР
City Planning (L1066)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Carsten Gertz		
Admission Requirements	None		
Recommended Previous	for "Principles of Urban Planning": none		
Knowledge	for "Designing Urban Streetscapes": some knowledge of transport planning, e.g. through taking t	the undergrad	uate class "Transpor
	Planning and Traffic Engineering"	5	
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	Students are able to:		
	use technical terms of urban planning.		
	 describe the main determinants of urban development. explain and compare different possibilities of how urban development can be influenced. 		
	 discuss requirements for public streetscapes. 		
	explain the importance of street design.		
Skills	Students are able to:		
	 read and analyze urban development concepts and designs for streetscapes 		
	 appraise such concepts in the context of competing requirements. 		
	 design, justify and reflect their own solutions for concrete examples. 		
Personal Competence			
Social Competence	Students are able to:		
	discuss intermediate results with each other.		
	 constructively accept feedback on their own work. 		
	 provide constructive feedback to others. 		
4			
Autonomy	Students are able to:		
	 independently complete a written report including drawings following a broadly pre-define 	ed process.	
	assess the consequences of their proposed solutions.		
	 Independently acquire knowledge and apply this to new issues or problem areas. 		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Credit points	6		
Course achievement	None		
Examination	Written elaboration		
Examination duration and	written assignment, designwork during the semester		
scale			
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory		
	Logistics, initrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective Compuls	sory	
	Water and Environmental Engineering. Specialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Cities: Compulsory		

Course L1066: City Planning	
Тур	Project-/problem-based Learning
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Carsten Gertz
Language	DE
Cycle	SoSe
Content	"Principles of Urban Planning" deals with the determinants of urban development and their interactions. Topics include:
	 legal framework, instruments and methods of planning, functional requirements, stakeholders and actors basic design requirements different planning levels and historical contexts. The objective of the course is for students to acquire a basic understanding of urban development problems and approaches for solving them. They will also be able to comprehend the process of urban planning. The course also covers the various functional and aesthetic requirements for designing streetscape as the most important elements of public space. The project work deals with a real life scenario and includes drawing up a development plan, an urban design concept, a building masterplan and a street redesign.
Literature	Albers, Gerd; Wekel, Julian (2009) Stadtplanung: Eine illustrierte Einführung. Primus Verlag. Darmstadt. Frick, Dieter (2008) Theorie des Städtebaus: Zur baulich-räumlichen Organisation von Stadt. Wasmuth-Verlag. Tübingen Jonas, Carsten (2009) Die Stadt und ihr Grundriss. Wasmuth-Verlag. Tübingen Kostof, Spiro; Castillo, Greg (1998) Die Anatomie der Stadt. Geschichte städtischer Strukturen. Campus-Verlag. Frankfurt/New York.

Module M0977: Const	ruction Logistics and Project Manage	ment			
Courses					
Title		Тур	Hrs/wk	СР	
Construction Logistics (L1163)		Lecture	1	2	
Construction Logistics (L1164)		Recitation Section (small)	1	2	
Project Development and Managen	nent (L1161)	Lecture	1	1	
Project Development and Managen	nent (L1162)	Project-/problem-based Learning	1	1	
Module Responsible	Prof. Heike Flämig				
Admission Requirements	None				
Recommended Previous	none				
Knowledge					
Educational Objectives	After taking part successfully, students have reached t	he following learning results			
Professional Competence					
Knowledge	Students can				
	 give definitions of the main terms of constructio 	n logistics and project development and n	nanagement		
	 name advantages and disadvantages of internal 	or external construction logistics			
	 explain characteristics of products, demand and 	l production of construction objects and th	neir conseque	ences for construction	
	specific supply chains				
	differentiate constructions logistics from other log	ogistics systems			
Skills	Students can				
01110					
	carry out project life cycle assessments				
	 apply methods and instruments of construction 	logistics			
	 apply methods and instruments of project development and management 				
	apply methods and instruments of conflict management				
	 design supply and waste removal concepts for a 	construction project			
Personal Competence					
Social Competence	Students can				
	 noid presentations in and for groups and the set of a set first set in a shift in second set. 				
	apply methods of conflict solving skills in group	work and case studies			
Autonomy	Students can				
	 solve problems by holistic, systemic and flow or improve their prostivity, prosticities shills 	ented thinking		f	
	 Improve their creativity, negotiation skills, con studies 	flict and crises solution skills by applyin	g methods o	r moderation in case	
	studies				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	õ			
Credit points	6				
Course achievement	None				
Examination	Written elaboration				
Examination duration and	Two written papers with presentations				
scale					
Assignment for the	Civil Engineering: Specialisation Structural Engineering	: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineer	ing: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineering: E	lective Compulsory			
	Civil Engineering: Specialisation Water and Traffic: Elec	ctive Compulsory			
	International Management and Engineering: Specialisa	tion II. Civil Engineering: Elective Compuls	ory		
	International Management and Engineering: Specialisa	tion II. Logistics: Elective Compulsory			
	Logistics, Infrastructure and Mobility: Specialisation Pro	oduction and Logistics: Elective Compulso	гy		
	Logistics, Infrastructure and Mobility: Specialisation Inf	rastructure and Mobility: Elective Compuls	sory		
1					

Course L1163: Construction Logistics		
Тур	Lecture	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Heike Flämig	
Language	DE	
Cycle	SoSe	
Content	The lecture gives deeper insight how important logistics are as a competetive factor for construction projects and which issues are to be adressed.	
	 competetive factor logistics the concept of systems, planning and coordination of logistics material, equipment and reverse logistics IT in construction logistics elements of the planning model of construction logistics and their connections flow oriented logistics systems for construction projects logistics concepts for ready to use construction projects (especially procurement and waste removel logistics) best practice examples (construction logistics Potsdamer Platz, recent case study of the region) 	
Literature	Flämig, Heike: Produktionslogistik in Stadtregionen. In: Forschungsverbund Ökologische Mobilität (Hrsg.) Forschungsbericht Bd. 15.2. Wuppertal 2000. Krauss, Siri: Die Baulogistik in der schlüsselfertigen Ausführung, Bauwerk Verlag GmbH Berlin 2005. Lipsmeier, Klaus: Abfallkennzahlen für Neubauleistungen im Hochbau : Verlag Forum für Abfallwirtschaft und Altlasten, 2004. Schmidt, Norbert: Wettbewerbsfaktor Baulogistik. Neue Wertschöpfungspotenziale in der Baustoffversorgung. In: Klaus, Peter: Edition Logistik. Band 6. Deutscher Verkehrs-Verlag. Hamburg 2003. Seemann, Y.F. (2007): Logistikkoordination als Organisationseinheit bei der Bauausführung Wissenschaftsverlag Mainz in Aachen, Aachen. (Mitteilungen aus dem Fachgebiet Baubetrieb und Bauwirtschaft (Hrsg. Kuhne, V.): Heft 20)	

Course L1164: Construction Logistics	
Тур	Recitation Section (small)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Heike Flämig
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1161: Project Development and Management		
Тур	Lecture	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Heike Flämig, Dr. Anton Worobei	
Language	DE	
Cycle	SoSe	
Content	Within the lecture, the main aspects of project development and management are tought:	
	 Terms and definitions of project management Advantages and disadvantages of different ways of project handling organization, information, coordination and documentation cost and fincance management in projects time- and capacity management in projects specific methods and instruments for successful team work Contents of the lecture are deepened in special exercises.	
Literature	Projektmanagement-Fachmann. Band 1 und Band 2. RKW-Verlag, Eschborn, 2004.	
Course L1162: Project Development and Management		
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Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Heike Flämig, Dr. Anton Worobei	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0998: Statio	cs and Dynamics of Structures			
Courses				
Title		Тур	Hrs/w	k CP
Structural Dynamics (L1202)		Lecture	2	2
Structural Dynamics (L1203)		Recitation Sectio	n (large) 2	2
racture mechanics and fatigue in	steel structures (L0564)	Lecture	1	1
racture mechanics and fatigue in	steel structures (L0565)	Recitation Sectio	n (large) 1	1
Module Responsible	Prof. Uwe Starossek			
Admission Requirements	None			
Recommended Previous	Knowledge of linear structural analysis of	statically determinate and indeterm	inate structures; Mecha	nics I/II, Mathematics I/
Knowledge	Differential equations I			
Educational Objectives	After taking part successfully, students hav	e reached the following learning resul	ts	
Professional Competence				
Knowledge	After successful completion of this module	, the student can explain the basic a	aspects of dynamic effe	cts on structures and th
Skills	After successful completion of this module, the students will be able to predict the response of material and structures to dynamics loading using the appropriate computational approaches and methods.			
Personal Competence Social Competence	Students can			
	 participate in subject-specific and int 	erdisciplinary discussions,		
	defend their own work results in fron	t of others		
	• promote the scientific development of	of colleagues		
	• Furthermore, they can give and acce	pt professional constructive criticism		
Autonomi	Students are able to gain knowledge of the	subject area from given and other ca	urcos and apply it to as	w problems Eurthermer
Autonomy	they are able to structure the solution proce	ess for problems in the area of Structu	iral Analysis.	w problems. Furthermore
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	150 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural	Engineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Structural	al Engineering: Elective Compulsory		
ronowing curricula	Civil Engineering: Specialisation Geotechnic	an engineering. Elective Compulsory		
	Civil Engineering: Specialisation Codstal Eng	Traffic: Elective Compulsory		
	International Management and Engineering	Specialisation II. Civil Engineering: E	ective Compulsory	
	meenational management and Engineering	. Specialisation II. Civil Engineering: E	ceave compuisory	

Course L1202: Structural Dy	namics
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	SoSe
Content	 Single-degree-of-freedom systems: undamped and damped vibration, free vibration, forced vibrations due to harmonic, periodical or arbitrary loading, natural frequency, damping vibration isolation solution in the frequency-domain (Fourier transformation), solution in the time-domain multi-degree-of-freedom systems: continuous or discrete systems, modelling with finite elements, generalisation modal analysis power iteration according to v.Mises earthquake loading: seismological basics, response spectrum method wind-induced vibrations: engineering meteorology, aerodynamic, classification of excitation mechanisms
Literature	Clough, R.W., Penzien, J.: Dynamics of Structures. 2. Aufl., McGraw-Hill, New York, 1993.

Course L1203: Structural Dynamics		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Uwe Starossek	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0564: Fracture mec	hanics and fatigue in steel structures
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Jürgen Priebe
Language	DE
Cycle	SoSe
Content	 basics of fatigue stress and fatigue resistance and determination of fatigue strength,
	 determination and use of S-N-curves and classification of notch effects,
	set up of determination of fatigue strength under dynamic load using the accumulation formula by Palmgren-Miner,
	set up of determination of fatigue strength in different examples,
	basics of construction and design regarding the problem of material fatigue,
	basics of linear elastic fracture mechanics under static and dynamic load,
	determination of lifetime of steel construction based on linear elastic fracture mechanics in different examples.
Literature	Seeßelberg, C.; Kranbahnen - Bemessung und konstruktive Gestaltung; 3. Auflage; Bauwerk-Verlag; Berlin 2009
	• Kuhlmann, Dürr, Günther; Kranbahnen und Betriebsfestigkeit; in Stahlbau Kalender 2003; Verlag Ernst & Sohn; Berlin 2003
	Deutscher Stahlbau-Verband (Hrsg.); Stahlbau Handbuch Band 1 Teil B; 3. Auflage; Stahlbau-Verlagsgesellschaft; Köln 1996
	Petersen, C.; Stahlbau; 3. überarb. und erw. Auflage; Vieweg-Verlag; Braunschweig 1993
	• DIN V ENV 1993-1-1: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 1-1: Allgemeine Bemessungsregeln, Bemessungsregeln für den Hochbau; 1993
	• DIN V ENV 1993-6: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 6: Kranbahnen; 2001
	DIN-Fachbericht 126. Richtlinie zur Anwendung von DIN V ENV 1993-6; Nationales Anwendungsdokument (NAD); Berlin 2002

Course L0565: Fracture mechanics and fatigue in steel structures		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Jürgen Priebe	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0593: Building Materials and Building Preservation

Courses					
Title	Тур	Hrs	s/wk	СР	
Repair of Structures (L0255)	Lecture	1		1	
Mineral Building Materials (L0253)	Lecture	2		2	
Technology of mineral Building Mat	erials (L0256) Project-/problem-based Learn	ning 1		2	
Transport Processes in Building Ma	terials and Damage Processes (L0254) Lecture	1		1	
Module Responsible	Prof. Frank Schmidt-Döhl				
Admission Requirements	None				
Recommended Previous	Basic knowledge about building materials, building physics and building chemistry, for	example	by the m	odules Principles of	
Knowledge	Building Materials and Building Physics and Building Materials and Building Chemistry.				
Educational Objectives	After taking part successfully, students have reached the following learning results				
Professional Competence					
Knowledge	The students are able to describe the components of mineral building materials and their fu	nction in	detail and	to use them for the	
	manufacture of special mineral building materials. They are able to show the characteristics	of minera	al building	materials. They are	
	able to describe the manufacture, properties and fields of application of special mortars and	l special c	concretes	and the correlations	
	of their material parameters. They are able to show the principles of anchor technology and	design.			
Skills	The students are able to perform an optimization of granulometry of a mineral building main the students are able to perform an optimization of granulometry of a mineral building main the students are able to perform an optimization of granulometry of a mineral building main the students are able to perform an optimization of granulometry of a mineral building main the students are able to perform an optimization of granulometry of a mineral building main the students are able to perform an optimization of granulometry of a mineral building main the students are able to perform an optimization of granulometry of a mineral building main the students are able to perform an optimization of granulometry of a mineral building main the students are able to perform an optimization of granulometry of a mineral building main the students are able to perform an optimization of granulometry of a mineral building main the students are able to perform an optimization of granulometry of a mineral building main the students are able to perform an optimization of granulometry of a mineral building main the students are able to perform an optimization of granulometry of a mineral building main the students are able to perform an optimization of granulometry of a mineral building main the students are able to perform an optimization of granulometry of a mineral building main the students are able to perform an optimization of granulometry of a mineral building main the students are able to perform an optimization of granulometry of a mineral building main the students are able to perform an optimization of granulometry of a mineral building main the students are able to perform an optimization of granulometry of a mineral building main the students are able to perform an optimization and an optimization are able to perform an optimization are able to p	erial. The	ey are able	e to design a special	
	mineral mortar and to manufacture this mortar. The students are able to manufacture post installed rebar connections. They are				
	able to recognize damages, to assess possible causes, to use the fundamentals of construction preservation and to select repair				
	and strengthening measures.				
Personal Competence					
Social Competence	The students are able to develop in small grous the mixture of a special mortar. They present their results to the lecturer and the				
	other students. In a critical discussion they defend and adjust their results. The students are able to manufacture their special				
	building material on the basis of this feedback.				
Autonomy	The students are able to responsibly use the resources of materials and lab equipment for their project and to investigate and to				
	get missing components.				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points	6				
Course achievement	Compulsory Bonus Form Description				
	Yes 20 % Subject theoretical and				
	practical work				
Examination	Written exam				
Examination duration and	120 min				
scale					
Assignment for the	Civil Engineering: Specialisation Geotechnical Engineering: Compulsory				
Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory				
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory				
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory				
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Course L0255: Repair of Structures		
Тур	Lecture	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Frank Schmidt-Döhl	
Language	DE	
Cycle	SoSe	
Content	Maintenance of structures, repair and strengthening, subsequent waterproofing of structures	
Literature	BetonMarketing Deutschland (Hrsg.): Stahlbetonoberflächen - schützen, erhalten, instandsetzen	

Course L0253: Mineral Building Materials			
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Frank Schmidt-Döhl		
Language	DE		
Cycle	SoSe		
Content	Components of mineral building materials and their function, binding materials, concrete and mortar, special mortars, special		
	concretes		
Literature	Taylor, H.F.W.: Cement Chemistry		
	Springenschmid, R.: Betontechnologie für die Praxis		

Course L0256: Technology of mineral Building Materials		
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Frank Schmidt-Döhl	
Language	DE	
Cycle	SoSe	
Content	Design and production of a special mineral building material	
Literature	Taylor, H.F.W.: Cement Chemistry	
	Springenschmid, R.: Betontechnologie für die Praxis	

Course L0254: Transport Processes in Building Materials and Damage Processes		
Тур	Lecture	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Frank Schmidt-Döhl	
Language	DE	
Cycle	SoSe	
Content	Transport Processes in Building Materials and Damage Processes	
Literature	Blaich, J.: Bauschäden, Analyse und Vermeidung	

Module M0999: Steel	Construction Project			
Courses				
Title		Тур	Hrs/wk	СР
Steel Construction Project (L1206)		Project Seminar	4	6
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
Recommended Previous	Steel and Composite Structures			
Knowledge				
Educational Objectives	After taking part successfully, students have	ve reached the following learning results		
Professional Competence				
Knowledge	Students are able to prepare a part of the	whole project and explain it to the others.		
Skills	Students can produce sketches and calculations of their part of the project. They are able to adjust their work in reaction to			
	changing conditions resulting from other p	articipants of the project.		
Personal Competence				
Social Competence	Students can present their results to other	members of the group.		
	They have the ability to work for a broad agreement with respect to intergroup dependencies.			
	They can distribute and process tasks inde	pendently.		
Autonomy	Students can handle their part of the proje	ct on their own resposibility-		
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	approx. 15-20 pages (without appendix)			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechni	cal Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Er	ngineering: Elective Compulsory		
	Civil Engineering: Specialisation Structural	Engineering: Compulsory		

Course L1206: Steel Construction Project	
Тур	Project Seminar
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Marcus Rutner
Language	DE
Cycle	SoSe
Content	Design of a big construction project (i.e skyscraper, large bridge, roof of a stadiuim) in small groups
Literature	Wird je nach Projekt individuell angegeben.

Module M0663: Marir	e Geotechnics			
Courses				
Title		Тур	Hrs/wk	СР
Marine Geotechnics (L0548)		Lecture	1	2
Marine Geotechnics (L0549)		Recitation Section (large)	2	2
Steel Structures in Foundation and	Hydraulic Engineering (L1146)	Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous	complete modules: Geotechnics I-III, Mather	natics I-III		
Knowledge	courses: Soil laboratory course	courses: Soil laboratory course		
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnic	al Engineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Structural E	ingineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Eng	ineering: Compulsory		
	Theoretical Mechanical Engineering: Special	isation Maritime Technology: Elective Compulsor	У	
	Theoretical Mechanical Engineering: Technic	cal Complementary Course: Elective Compulsory		
	Water and Environmental Engineering: Spec	ialisation Cities: Elective Compulsory		
	Water and Environmental Engineering: Spec	ialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Spec	ialisation Water: Elective Compulsory		

Course L0548: Marine Geotechnics	
Тур	Lecture
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	SoSe
Content	 Geotechnical investigation an description of the seabed Foundations of Offshore-Constructions cCliff erosion Sea dikes Port structures Flood protection structures
Literature	 EAK (2002): Empfehlungen für Küstenschutzbauwerke EAU (2004): Empfehlungen des Arbeitsausschusses Uferbauwerke Poulos H.G. (1988): Marine Geotechnics. Unwin Hyman, London Wagner P. (1990): Meerestechnik: Eine Einführung für Bauingenieure. Ernst & Sohn, Berlin

Course L0549: Marine Geotechnics	
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1146: Steel Structures in Foundation and Hydraulic Engineering	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Frank Feindt
Language	DE
Cycle	SoSe
Content	Design of a sheet pile wall, design of a combined sheet pile wall, piles, walings, connections, fatigue
Literature	EAU 2012, EA-Pfähle, EAB

Module M1350: Excav	ation Law and Projects			
Courses				
courses				
Title		Тур	Hrs/wk	СР
Subsoil and Underground Engineer	ng Law (L0395)	Lecture	2	2
Service Contract and Procurement	aw (L1906)	Lecture	2	2
Project Geotechnics (L0708)		Project-/problem-based Learning	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and	30 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Ele	ctive Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineerin	g: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineering: I	Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Electi	ve Compulsory		
L				

Course L0395: Subsoil and Underground Engineering Law		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Günther Schalk	
Language	DE	
Cycle	WiSe	
Content	History of Civil Engineering Law (from 1700 BC to 2000 AD)	
	• Basics of foundation and excarvation law / engineering law (the participants in the case law of geotechnical law case studies)	
	• Legal aspects of technical regulations in civil engineering (with case studies)	
	• The civil engineering contract (including checklists for the special civil engineering contract design and execution)	
	• The liability of the planner and entrepreneur in civil engineering (practical examples, jurisprudence and law, inter alia, to the Ordinance on Combatants, liability for defects and traffic safety obligations, construction law and insurance questions)	
	• The ground / foundation risk and the systemic risk (also in the European context)	
	The total debt in (low) building law (based on practice-oriented case constellations)	
	• The (construction) conflict, the dispute avoidance models and the construction process (practice-oriented presentation)	
Literature	Folienskript (in der Vorlesung erhältlich)	
	weitere Literatur:	
	Englert, Grauvogel und Maurer: Handbuch des Baugrund- und Tiefbaurechts. Werner-Verlag	

Course L1906: Service Contract and Procurement Law	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Günther Schalk, Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	
Literature	

Module Manual M.Sc. "Civil Engineering"

Course L0708: Project Geotechnics	
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	The students solve independently a project-based geotechnical problem in groups. Additional lectures concerning the problem will
	be held and material will be distributed as study basis. Every two weeks the groups present their current project status. The final
	work will be presentated in a final presentation.
Literature	abhängig von der Fragestellung

Module M1345: Meta	llic and Hybrid Light-weight Materi	als		
Courses				
Title		Тур	Hrs/wk	СР
Joining of Polymer-Metal Lightweig	ht Structures (L0500)	Lecture	2	2
Joining of Polymer-Metal Lightweig	ht Structures (L0501)	Practical Course	1	1
Metallic Light-weight Materials (L10	560)	Lecture	2	3
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Lecture	re 70		
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and	45 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Enginee	ring: Elective Compulsory		
Following Curricula	Materials Science: Specialisation Engineering Mate	rials: Elective Compulsory		

Course L0500: Joining of Poly	/mer-Metal Lightweight Structures
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Marcus Rutner
Language	EN
Cycle	WiSe
Content	Contents:
	The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologies for polymer-metal lightweight structures used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of applications is to be accomplished through theoretical and practical lectures. Theoretical Lectures:
	 Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joining Technology Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics Mechanical Fastening of Polymer-Metal Hybrid Structures Adhesive Bonding of Polymer-Metal Hybrid Structures Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures
	Laboratory Exercises: • Joining Processes: Introduction to state-of-the-art joining technologies • Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal joints
	Course Outcomes: After successful completion of this unit, students should be able to understand the principles of welding and joining of polymer- metal lightweight structures as well as their application fields.
Literature	 S. T. Amancio-Filho, LA. Blaga, Joining of Polymer-Metal Hybrid Structures, Wiley, 2018 J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers D.A. Grewell, A. Benatar, J.B. Park, Plastics and Composites Welding Handbook D. Lohwasser, Z. Chen, Friction Stir Welding, From basics to applications, Woodhead Publishing Limited J. Friedrich, Metal-Polymer Systems: Interface Design and Chemical Bonding, Wiley, 2017

Course L0501: Joining of Polymer-Metal Lightweight Structures	
Тур	Practical Course
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Marcus Rutner
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1660: Metallic Light-weight Materials					
Тур	Lecture				
Hrs/wk	2				
Workload in Hours	idependent Study Time 62, Study Time in Lecture 28				
Lecturer	r. Domonkos Tolnai				
Language	EN				
Cycle	iSe				
	- Structural lightweight construction				
	- Material lightweight construction				
	- Choice criteria for metallic lightweight construction materials				
	Steel as lightweight construction materials				
	- Introduction to the fundamentals of steels				
	- Modern steels for the lightweight construction				
	- Fine grain steels				
	- High-strength low-alloyed steels				
	- Multi-phase steels (dual phase, TRIP)				
	- Weldability				
	- Applications				
	Aluminium alloys:				
	Introduction to the fundamentals of aluminium materials Alloy systems				
Non age-hardenable Al alloys: Processing and microstructure, mechanical qualities applications Age-hardenable Al alloys: Processing and microstructure, mechanical qualities and application					
					Magnesium alloys
	Introduction to the fundamental of magnesium materials				
	Alloy systems				
	Magnesium casting alloys, processing, microstructure and qualities				
	Magnesium wrought alloys, processing, microstructure and qualities				
	Examples of applications				
	Titanium alloys				
	Introduction to the fundamental of the titanium materials				
	Alloy systems				
	Processing, microstructure and properties				
	Examples of applications				

	Exercises and excursions				
Literature	George Krauss, Steels: Processing, Structure, and Performance, 978-0-87170-817-5, 2006, 613 S.				
	Hans Berns, Werner Theisen, Ferrous Materials: Steel and Cast Iron, 2008. http://dx.doi.org/10.1007/978-3-540-71848-2				
	C. W. Wegst, Stahlschlüssel = Key to steel = La Clé des aciers = Chiave dell'acciaio = Liave del acero ISBN/ISSN: 3922599095				
	Bruno C., De Cooman / John G. Speer: Fundamentals of Steel Product Physical Metallurgy, 2011, 642 S.				
	Harry Chandler, Steel Metallurgy for the Non-Metallurgist 0-87170-652-0, 2006, 84 S.				
	Catrin Kammer, Aluminium Taschenbuch 1, Grundlagen und Werkstoffe, Beuth, 16. Auflage 2009. 784 S., ISBN 978-3-410-22028-2				
	Günter Drossel, Susanne Friedrich, Catrin Kammer und Wolfgang Lehnert, Aluminium Taschenbuch 2, Umformung von Aluminium-Werkstoffen, Gießen von Aluminiumteilen, Oberflächenbehandlung von Aluminium, Recycling und Ökologie, Beuth, 16. Auflage 2009. 768 S., ISBN 978-3-410-22029-9				
Catrin Kammer, Aluminium Taschenbuch 3, Weiterverarbeitung und Anwendur Auflage 2014. 892 S., ISBN 978-3-410-22311-5					
	G. Lütjering, J.C. Williams: Titanium, 2nd ed., Springer, Berlin, Heidelberg, 2007, ISBN 978-3-540-71397				
	Magnesium - Alloys and Technologies, K. U. Kainer (Hrsg.), Wiley-VCH, Weinheim 2003, ISBN 3- 527-30570-x				
	Mihriban O. Pekguleryuz, Karl U. Kainer and Ali Kaya "Fundamentals of Magnesium Alloy Metallurgy", Woodhead Publishing Ltd, 2013,ISBN 10: 0857090887				

Module M1716: Subs	urface Processes			
Courses				
Title Typ Hrs/wk CP				
Modeling of Subsurface Processes	(L2730)	Lecture	2	2
Modeling of Subsurface Processes	(L2731)	Recitation Section (small)	1	1
Modern Techniques for Subsurface	Solute Transport (L2728)	Lecture	2	2
Modern Techniques for Subsurface	Solute Transport (L2729)	Recitation Section (large)	1	1
Module Responsible	Prof. Nima Shokri			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lectu	ire 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engin	eering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical En	gineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Enginee	ring: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traff	c: Elective Compulsory		
	Process Engineering: Specialisation Environment	al Process Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process Engi	neering: Elective Compulsory		
	Water and Environmental Engineering: Specialise	ation Water: Compulsory		
	Water and Environmental Engineering: Specialise	ation Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisa	ation Cities: Elective Compulsory		

Course L2730: Modeling of Subsurface Processes		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Sonja Götz	
Language	EN	
Cycle	WiSe	
Content		
Literature		

Course L2731: Modeling of Subsurface Processes		
Тур	Recitation Section (small)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Sonja Götz	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L2728: Modern Techniques for Subsurface Solute Transport		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Nima Shokri	
Language	EN	
Cycle	WiSe	
Content		
Literature		

Course L2729: Modern Techniques for Subsurface Solute Transport		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Hannes Nevermann	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M1437: Non destructive testing of materials and parts					
Courses					
Title		Тур	Hrs/wk	СР	
Non destructive testing of material	s and parts (L2215)	Lecture	2	2	
Non destructive testing of material	s and parts (L2217)	Project-/problem-based Learning	3	3	
Non destructive testing of material	s and parts (L2216)	Recitation Section (large)	1	1	
Module Responsible	Prof. Bodo Fiedler				
Admission Requirements	None				
Recommended Previous					
Knowledge					
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results			
Professional Competence					
Knowledge					
Skills					
Personal Competence					
Social Competence					
Autonomy					
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84				
Credit points	6				
Course achievement	None				
Examination	Written elaboration				
Examination duration and	Written document about theory and praxis				
scale					
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Electiv	ve Compulsory			
Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Electiv	ve Compulsory			
	Civil Engineering: Specialisation Geotechnical Engineering: I	Elective Compulsory			
	Civil Engineering: Specialisation Geotechnical Engineering: I	Elective Compulsory			
	Civil Engineering: Specialisation Structural Engineering: Elec	ctive Compulsory			
	Civil Engineering: Specialisation Structural Engineering: Elec	ctive Compulsory			
	Civil Engineering: Specialisation Water and Traffic: Elective	Compulsory			
	Civil Engineering: Specialisation Water and Traffic: Elective	Compulsory			
	Materials Science: Specialisation Engineering Materials: Elec	tive Compulsory			

Course L2215: Non destructive testing of materials and parts			
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Marcus Rutner, Prof. Robert Meißner		
Language	DE/EN		
Cycle	WiSe		
Content	This strongly interdisciplinary lecture and practical course is offered to Masterstudents who are interesed to learn about an		
	important field across engineering and material science industries, i.e. nondestructive testing of materials and parts.		
	Interdisciplinary approaches and thinking becomes more and more important since many problems extend into various disciplines,		
hence, can only be solved through interdisciplinary thinking and collaboration. Accordingly, this module combines			
	different disciplines, i.e. mechanical engineering, civil engineering, materials science and computer science with a touch of		
	electrical engineering. Nondestructive testing (NDT) is the process of inspecting, testing, and evaluating materials, parts, and		
	assemblies to understand properties and defects without causing damage to the material or part. This scientific approach enables		
	to make intrinsic material and component characteristics visible. Hence, the approach links detection approaches (e.g. linear and		
	nonlinear acoustic methods, ultrasonic testing, Magnetic Particle Testing, thermo-chemical methods, etc.) with material physics		
	and the mechanics of components, further, with evaluation, interpretation, big data management, transmission of data, and		
	cybersecurity. The module embraces a lecture and a practical course. Contents of the lecture are NTD technologies and their		
	theory behind, evaluation, transmission of data, while the students will apply the NDT technologies during the practical course in		
	the experimental test halls and labs at TUHH. Lecture and practical course split into the major themes: A) Detection: Theory and		
	Practice B) Evaluation of Data: Theory and Practice C) Data Acquisition and Transmission with Wireless, Batteryless Sensor		
	Devices:Theory and Practice		
Literature			

Course L2217: Non destructive testing of materials and parts		
Тур	Project-/problem-based Learning	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Marcus Rutner, Prof. Robert Meißner	
Language	DE/EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L2216: Non destructive testing of materials and parts				
Тур	Recitation Section (large)			
Hrs/wk	1			
СР	1			
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14			
Lecturer	Prof. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Marcus Rutner, Prof. Robert Meißner			
Language	DE/EN			
Cycle	WiSe			
Content	This strongly interdisciplinary lecture and practical course is offered to Masterstudents who are interesed to learn about an			
	important field across engineering and material science industries, i.e. nondestructive testing of materials and parts.			
	Interdisciplinary approaches and thinking becomes more and more important since many problems extend into various disciplines,			
hence, can only be solved through interdisciplinary thinking and collaboration. Accordingly, this module combines the e different disciplines, i.e. mechanical engineering, civil engineering, materials science and computer science with a				
				electrical engineering. Nondestructive testing (NDT) is the process of inspecting, testing, and evaluating materials, part
	assemblies to understand properties and defects without causing damage to the material or part. This scientific approach enables			
	to make intrinsic material and component characteristics visible. Hence, the approach links detection approaches (e.g. linear and			
	nonlinear acoustic methods, ultrasonic testing, Magnetic Particle Testing, thermo-chemical methods, etc.) with material physics			
	and the mechanics of components, further, with evaluation, interpretation, big data management, transmission of data, and			
	cybersecurity. The module embraces a lecture and a practical course. Contents of the lecture are NTD technologies and their			
	theory behind, evaluation, transmission of data, while the students will apply the NDT technologies during the practical course in			
	the experimental test halls and labs at TUHH. Lecture and practical course split into the major themes: A) Detection: Theory and			
	Practice B) Evaluation of Data: Theory and Practice C) Data Acquisition and Transmission with Wireless, Batteryless Sensor			
	Devices:Theory and Practice			
Literature				

Module M0581: Wate	r Protection			
Courses				
Title		Тур	Hrs/wk	СР
Water Protection and Wastewater M	Aanagement (L0226)	Lecture	3	3
Water Protection and Wastewater N	Management (L2008)	Project Seminar	3	3
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Kecommended Previous	 Basic knowledge in water management; 			
Kilowieuge	 Good knowledge in urban drainage; 			
	 Good knowledge of wastewater treatme 	nt techniques;		
	 Good knowledge of pollutants (e.g. COD 	, BOD, TS, N, P) and their properties;		
Educational Objectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence				
Knowledge	The students can describe the basic principles	of the regulatory framework related to the i	nternational and Eu	ropean water sector.
	They can explain limnological processes, sub	ostance cycles and water morphology in d	etail. They are able	e to assess complex
	problems related to water protection, such as	s ecosystem service and wastewater treatr	nent with a special	focus on innovative
	solutions, remediation measures as well as cor	nceptual approaches.		
Skills	Students can accurately assess current proble	ms and situations in a country-specific or lo	ocal context. They o	an suggest concrete
	actions to contribute to the planning of tom	orrow's urban water cycle. Furthermore, t	ney can suggest a	opropriate technical,
	administrative and legislative solutions to solve	e these problems.		
Personal Competence				
Social Competence	The students can work together in internationa	ll groups.		
Autonomy	Students are able to organize their work flow	to prepare presentations and discussions. T	hey can acquire ap	propriate knowledge
	by making enquiries independently.			
Workload in Hours	Independent Study Time 96, Study Time in Lec	ture 84		
Credit points	6			
Course achievement	None			
Examination	Presentation			
Examination duration and	Term paper plus presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Eng	ineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical	Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engine	eering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Tra	ffic: Elective Compulsory		
	Environmental Engineering: Specialisation Wat	er: Elective Compulsory		
	International Management and Engineering: Sp	pecialisation II. Civil Engineering: Elective Co	mpulsory	
	Joint European Master in Environmental Studie	s - Cities and Sustainability: Specialisation W	later: Elective Comp	oulsory
	Water and Environmental Engineering: Special	isation Cities: Elective Compulsory		
	water and Environmental Engineering: Special			
	water and Environmental Engineering: Special	isación Environment. Compuisory		

Course L0226: Water Protect	ion and Wastewater Management
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	WiSe
Content	 The lecture focusses on: Regulatory Framework (e.g. WFD) Main instruments for the water management and protection
	 In depth knowledge of relevant measures of water pollution control Urban drainage, treatment options in different regions on the world Rainwater management, improved management of heavy rainfalls, downpours, rainwater harvesting, rainwater infiltration Case Studies and Field Trips
Literature	 The literature listed below is available in the library of the TUHH. Water and wastewater technology Hammer, M. J. 1., & . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Education International. Water and wastewater engineering : design principles and practice: Davis, M. L. 1. (2011) New York, NY: McGraw-Hill. Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ.

Course L2008: Water Protection and Wastewater Management				
Тур	Project Seminar			
Hrs/wk	3			
СР	3			
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42			
Lecturer	Prof. Ralf Otterpohl			
Language	EN			
Cycle	WiSe			
Content				
Literature				

Module M0595: Exam	ination of Materials, Structural Cor	dition and Damages			
Courses					
Title		Тур	Hrs/wk	СР	
Examination of Materials, Structura	ll Condition and Damages (L0260)	Lecture	3	4	
Examination of Materials, Structura	I Condition and Damages (L0261)	Recitation Section (small)	1	2	
Module Responsible	Prof. Frank Schmidt-Döhl				
Admission Requirements	None				
Recommended Previous	Basic knowledge about building materials or ma	aterial science, for example by the mod	ule Building M	aterials and Building	
Knowledge	Chemistry.				
Educational Objectives	After taking part successfully, students have reached	ed the following learning results			
Professional Competence					
Knowledge	The students are able to describe the rules for tra methods for the testing of building material proper testing methods.	ding, use and marking of construction pro ties are usable and know the limitations an	ducts in Germa d characterics	any. They know which of the most important	
Skills	The students are able to responsibly discover the rules for trading and using of building products in Germany. They are able to chose suitable methods for the testing and inspection of construction products, the examination of damages and the examination of the structural conditions of buildings. They are able to conclude from symptons to the cause of damages. They are able to describe an examination in form of a test report or expert opinion.				
Personal Competence Social Competence	The students can describe the different roles of m framework of material testing. They can describe th	anufacturers as well as testing, supervisor ne different roles of the participants in legal	y and certificat proceedings.	tion bodies within the	
Autonomy	The students are able to make the timing and the o	peration steps to learn the specialist knowl	edge of a very	extensive field.	
Workload in Hours	Independent Study Time 124, Study Time in Lectur	e 56			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	120 min				
scale					
Assignment for the	Civil Engineering: Specialisation Structural Enginee	ring: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engir	eering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineerin	g: Elective Compulsory			
	Civil Engineering: Specialisation Water and Traffic:	Elective Compulsory			
	International Management and Engineering: Specia	lisation II. Civil Engineering: Elective Comp	ulsory		
	Materials Science: Specialisation Engineering Mater	ials: Elective Compulsory			

Course L0260: Examination of Materials, Structural Condition and Damages Typ Lecture Lecture 3 OCP 4 Workload in Hours Independent Study Time 78, Study Time in Lecture 42 Lecturer Prof. Frank Schmidt-Döhl Language DE Content Materials testing and marking process of construction products, testing methods for building materials and structures, testing reports and expert opinions, describing the condition of a structure, from symptons to the cause of damages Literature Frank Schmidt-Döhl: Materialprüfung im Bauwesen. Fraunhofer irb-Verlag, Stuttgart, 2013.

Course L0261: Examination of Materials, Structural Condition and Damages				
Тур	Recitation Section (small)			
Hrs/wk	1			
СР	2			
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14			
Lecturer	Prof. Frank Schmidt-Döhl			
Language	DE			
Cycle	WiSe			
Content	See interlocking course			
Literature	See interlocking course			

Courses						
Title		Тур		Hrs/wk	СР	
Nonlinear Structural Analysis (L027	7)	Lecture		3	4	
Nonlinear Structural Analysis (L027	9)	Recitation See	ction (small)	1	2	
Module Responsible	Prof. Alexander Düster					
Admission Requirements	None					
Recommended Previous	Knowledge of partial differential equation	ons is recommended.				
Knowledge						
Educational Objectives	After taking part successfully, students	have reached the following learning re	sults			
Professional Competence						
Knowledge	Students are able to					
	+ give an overview of the different non	inear phenomena in structural mechar	nics.			
	+ explain the mechanical background of	f nonlinear phenomena in structural m	echanics.			
	+ to specify problems of nonlinear stru	ctural analysis, to identify them in a g	iven situation a	ind to explain the	eir mathematical an	
	mechanical background.					
Skills	Students are able to					
Skiis	+ model nonlinear structural problems					
	+ select for a given poplinear structura	problem a suitable computational pro	cedure			
	\pm apply finite element procedures for n	onlinear structural analysis	ccuure.			
	+ critically verify and judge results of n	onlinear finite elements				
	- cruccary verify and judge results of nonlinear finite elements.					
	i to transfer their knowledge of homme	ar solution procedures to new problem	13.			
Personal Competence						
Social Competence	Students are able to					
	+ solve problems in heterogeneous gro	ups and to document the correspondin	ig results.			
	+ share new knowledge with group me	mbers.				
4	Chudanta ana akia ta					
Autonomy	Students are able to	salva complex problems				
	+ acquire independently knowledge to	solve complex problems.				
Workload in Hours	Independent Study Time 124, Study Tin	ne in Lecture 56				
Course achievement	0 None					
Evamination	Written exam					
Examination duration and	120 min					
scale	120 1111					
Assignment for the	Civil Engineering: Specialisation Structu	ral Engineering: Elective Compulsory				
Eollowing Curricula	International Management and Engines	ring: Specialisation II. Civil Engineering	. Elective Comr	ulson		
i onowing curricula	Materials Science: Specialisation Model	ng: Elective Compulsory	. Liective Comp	Juisony		
	Machatronics: Specialisation System Dr	sign: Elective Compulsory				
	Breduct Development, Materials and Br	aduction: Coro Qualification: Flactive C	ompulson			
	Noval Architecture and Ocean Engineer	ing Core Qualification: Elective Comp	unpuisory			
	Chin and Offeners Technology Com Ou	lifestion. Elective Compu	lisory			
	Theoretical Mechanical Engineering: Core Qu		stive Comput-			
	meoretical Mechanical Engineering: Sp	ecialisation Simulation Technology: Ele	cuve compuiso	лу		

Course L0277: Nonlinear Str	uctural Analysis
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Alexander Düster
Language	DE/EN
Cycle	WiSe
Content	1. Introduction
	2. Nonlinear phenomena
	3. Mathematical preliminaries
	4. Basic equations of continuum mechanics
	5. Spatial discretization with finite elements
	6. Solution of nonlinear systems of equations
	7. Solution of elastoplastic problems
	8. Stability problems
	9. Contact problems
Literature	[1] Alexander Düster, Nonlinear Structrual Analysis, Lecture Notes, Technische Universität Hamburg-Harburg, 2014.
	[2] Peter Wriggers, Nonlinear Finite Element Methods, Springer 2008.
	[3] Peter Wriggers, Nichtlineare Finite-Elemente-Methoden, Springer 2001.
	[4] Javier Bonet and Richard D. Wood, Nonlinear Continuum Mechanics for Finite Element Analysis, Cambridge University Press,
	2008.

Course L0279: Nonlinear Structural Analysis				
Тур	Recitation Section (small)			
Hrs/wk	1			
СР	2			
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14			
Lecturer	Prof. Alexander Düster			
Language	DE/EN			
Cycle	WiSe			
Content	See interlocking course			
Literature	See interlocking course			

Module M0619: Waste	e Treatment Teo	chnologies				
Courses						
Title				Тур	Hrs/wk	СР
Waste and Environmental Chemist	ry (L0328)			Practical Course	2	2
Biological Waste Treatment (L0318	;)			Project-/problem-based Learning	3	4
Module Responsible	Prof. Kerstin Kuchta					
Admission Requirements	None					
Recommended Previous	chemical and biologica	al basics				
Knowledge						
Educational Objectives	After taking part succe	essfully, students have r	eached the followi	ng learning results		
Professional Competence						
Knowledge	The module aims poss design and layout of a plants for biological wa	ess knowledge concerni naerobic and aerobic wa aste treatment plants ar	ing the planning of aste treatment plai nd explain different	biological waste treatment plan nts in detail, describe different t methods for waste analytics.	its. Students a echniques for	re able to explain the waste gas treatment
Skills	The students are able control measurements and plan additional tes	The students are able to discuss the compilation of design and layout of plants. They can critically evaluate techniques and quality control measurements. The students can recherché and evaluate literature and date connected to the tasks given in der module and plan additional tests. They are capable of reflecting and evaluating findings in the group.				
Personal Competence						
Social Competence	Students can participa	ate in subject-specific a	nd interdisciplinary	discussions develop cooperat	ed solutions a	nd defend their own
	work results in front of others and promote the scientific development in front of colleagues. Furthermore, they can give and accept professional constructive criticism.					
Autonomy	Students can independently tap knowledge from literature, business or test reports and transform it to the course projects. They are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define further steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with the potential social, economic and cultural impact.					
Markland in House	lades es dest Chudu Tir	na 110. Chudu Tima in I	70			
Credit points		në 110, Study Time in D	ecture 70			
Course achievement	Compulsory Bonus	Form	Description			
course acmevement	Yes None	Subject theoretical	and			
		practical work				
Examination	Presentation					
Examination duration and	Elaboration and Preser	ntation (15-25 minutes i	n groups)			
scale						
Assignment for the	Civil Engineering: Spec	cialisation Structural Eng	gineering: Elective	Compulsory		
Following Curricula	Civil Engineering: Spec	cialisation Geotechnical	Engineering: Electi	ve Compulsory		
	Civil Engineering: Spec	cialisation Coastal Engin	eering: Elective Co	mpulsory		
	Civil Engineering: Spec	cialisation Water and Tra	affic: Elective Com	oulsory		
	Energy and Environme	ental Engineering: Speci	alisation Environm	ental Engineering: Elective Com	pulsory	
	Environmental Engine	ering: Core Qualification	: Compulsory			
	International Managen	nent and Engineering: S	pecialisation II. Ene	ergy and Environmental Enginee	ering: Elective	Compulsory
	Joint European Master	in Environmental Studie	es - Cities and Sust	ainability: Specialisation Energy	: Elective Com	pulsory
	Water and Environmen	ntal Engineering: Specia	lisation Cities: Elec	tive Compulsory		
	water and Environmen	itai Engineering: Specia	isation Environme	nt: Elective Compulsory		

Course L0328: Waste and En	vironmental Chemistry
Тур	Practical Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Kerstin Kuchta
Language	DE/EN
Cycle	WiSe
Content	The participants are divided into groups. Each group prepares a transcript on the experiment performed, which is then used as basis for discussing the results and to evaluate the performance of the group and the individual student. In some experiments the test procedure and the results are presented in seminar form, accompanied by discussion and results evaluation. Experiments ar e.g. Screening and particle size determination Fos/Tac AAS Chalorific value
Literature	Scripte

Course L0318: Biological Wa	Course L0318: Biological Waste Treatment				
Тур	Project-/problem-based Learning				
Hrs/wk	3				
СР	4				
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42				
Lecturer	Prof. Kerstin Kuchta				
Language	EN				
Cycle	WiSe				
Content	 Introduction biological basics determination process specific material characterization aerobic degradation (Composting, stabilization) anaerobic degradation (Biogas production, fermentation) Technical layout and process design Flue gas treatment Plant design practical phase 				
Literature					

Module M0722: Comp	utation	al Ana	lysis of Concr	ete Structures			
Courses							
Title					Тур	Hrs/wk	СР
Computational Analysis of Concrete	e Structures	(L0598)			Lecture	2	3
Computational Analysis of Concrete	e Structures	(L0599)			Recitation Section (large)	1	1
FE-Modeling of Concrete Structures	s (L0600)				Project-/problem-based Learning	2	2
Module Responsible	Prof. Günte	er Romba	ich				
Admission Requirements	None						
Recommended Previous	Basic know	vledge in	structural analysis a	nd design of reinforced	concrete structures (beams, slab	s, shear walls).
Knowledge	Lectures '	Concrete	Structures I und II'				
	Lectures '	Structura	I Analysis I and II'				
	Lecture 'Co	oncrete S	tructures'				
Educational Objectives	After takin	g part su	ccessfully, students	have reached the followi	ng learning results		
Professional Competence							
Knowledge	The studer	The students know the problems of numerical modeling and design of an arbitrary concrete structure.					
Skills	The studer	The students can model and design an arbitrary concrete structure by means of a finite element software package.					
Personal Competence							
Social Competence	The studer	The students can model and design in teamwork a real constate structure by means of a finite element software nackage					
Social competence	The studen	The students can model and design in teamwork a real concrete structure by means of a inite element software package.					
Autonomy	The studer	The students can model and design a real concrete structure based on a finite element software package and discuss the problem					
	and results	and results with other students.					
Workload in Hours	Independe	nt Study	Time 110, Study Tin	ne in Lecture 70			
Credit points	6	,					
Course achievement	Compulsory	Bonus	Form	Description			
	Yes	None	Excercises	Es ist ein Tra	gsystem mit TEDDY zu modellier	ren	
	Yes	None	Attestation	Am Ende d	es Semster ist ein Tragsystem	n mit dem F	Rechenprogramm zu
				modellieren			
Examination	Oral exam						
Examination duration and	45 min						
scale							
Assignment for the	Civil Engin	eering: S	pecialisation Structu	ral Engineering: Elective	Compulsory		
Following Curricula	Civil Engin	eering: S	pecialisation Geotec	hnical Engineering: Elect	ive Compulsory		
	Civil Engin	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory					
	Civil Engin	eering: S	pecialisation Water a	and Traffic: Elective Com	pulsory		

Course L0598: Computationa	I Analysis of Concrete Structures
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	WiSe
Content	 Modeling of beam and truss structures Discontinuity regions, like frame corners, openings, shear walls with large openings Bracing of high-rise buildings Modeling of bridges Nonlinear analysis Finite-Elemente-analysis of slabs: support conditions, singularity regions Finite-Elemente-Berechnungen of shear walls and deep beams: support condition, design Coupled systems Modeling of slab supported on beams Shell structures 3D building models Nonlinear analysis of slabs and shells Documentation
Literature	 Vorlesungsumdruck Rombach, G.A. (2007): Anwendung der Finite-Elemente-Methode im Betonbau. 2. Auflage, Verlag Ernst & Sohn, Berlin Rombach G.A. (2011): Finite-Element Design of Concrete Structures, 2nd edition, ICE publishing Hartmann, F., Katz, C. (2002): Statik mit finiten Elementen. Springer, Berlin

Course L0599: Computational Analysis of Concrete Structures	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L0600: FE-Modeling o	of Concrete Structures
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Lukas Henze
Language	DE
Cycle	WiSe
Content	Finite Element Modeling and computational design of concrete structures by 'SOFISTIK'
Literature	 Rombach G.: Anwendung der Finite - Elemente - Methode im Betonbau. 2. Auflage. Verlag Ernst & Sohn, Berlin, 2007 Rombach G.: Finite-Element Design of Concrete Structures. 2nd edition, ICE Publishing, London, 2011, ISBN 0 7277 32749 Rombach G.: EDV-unterstützte Berechnungen im Stahlbetonbau. in: "Stahlbetonbau aktuell 2014" (ed. Gorris A., Hegger J., Mark P.), Berlin 2014 (S. C1C.36)

Module M0801: Water Resources and -Supply				
Courses				
Title		Тур	Hrs/wk	СР
Chemistry of Drinking Water Treat	nent (L0311)	Lecture	2	1
Chemistry of Drinking Water Treat	nent (L0312)	Recitation Section (large)	1	2
Water Resource Management (L04	02)	Lecture	2	2
Water Resource Management (L04	03)	Recitation Section (small)	1	1
Module Responsible	Prof. Mathias Ernst			
Admission Requirements	None			
Recommended Previous	Knowledge of water management and the key processes	involved in water treatment.		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
Knowledge	Students will be able to outline key areas of conflict in water management, as well as their mutual dependence for sustainable water supply. They will understand relevant economic, environmental and social factors. Students will be able to explain and outline the organisational structures of water companies. They will be able to explain the available water treatment processes and the scope of their application.			
	management and technical measures. They will be able be able to carry out chemical calculations for selected standards to these processes.	to assess the evaluation methods th treatment processes and apply ger	at can be used	for this. Students will d technical rules and
Personal Competence				
Social Competence	Working in a diverse group of specialists, students will and treatment of drinking water. They will be able to interests. They will be able to develop joint solutions in t	be able to develop and document cor take an appropriate professional posi eams of diverse experts and present t	nplex solutions tion, for examp hese solutions t	for the management ole representing user to others.
Autonomy		endentry and present on this subject.		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min (chemistry) + presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering:	Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering	g: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Comp	pulsory		
	Civil Engineering: Specialisation Coastal Engineering: Ele	ective Compulsory		
	International Management and Engineering: Specialisati	on II. Energy and Environmental Engin	eering: Elective	Compulsory
	Water and Environmental Engineering: Specialisation Wa	ater: Compulsory		
	Water and Environmental Engineering: Specialisation En	vironment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Cit	ies: Elective Compulsory		

Course L0311: Chemistry of Drinking Water Treatment		
Тур	Lecture	
Hrs/wk	2	
СР	1	
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Dr. Klaus Johannsen	
Language	DE	
Cycle	WiSe	
Content	The topic of this course is water chemistry with respect to drinking water treatment and water distribution	
	Major topics are solubility of gases, carbonic acid system and calcium carbonate, blending, softening, redox processes, materials and legal requirements on drinking water treatment. Focus is put on generally accepted rules of technology (DVGW- and DIN- standards). Special emphasis is put on calculations using realistic analysis data (e.g. calculation of pH or calcium carbonate dissolution potential) in exercises. Students can get a feedback and gain extra points for exam by solving problems for homework. Knowledge of drinking water treatment processes is vital for this lecture. Therefore the most important processes are explained coordinated with the course " Water resources management" in the beginning of the semester.	
Literature	 MHW (rev. by Crittenden, J. et al.): Water treatment principles and design. John Wiley & Sons, Hoboken, 2005. Stumm, W., Morgan, J.J.: Aquatic chemistry. John Wiley & Sons, New York, 1996. DVGW (Hrsg.): Wasseraufbereitung - Grundlagen und Verfahren. Oldenbourg Industrie Verlag, München, 2004. Jensen, J. N.: A Problem Solving Approach to Aquatic Chemistry. John Wiley & Sons, Inc., New York, 2003. 	

Course L0312: Chemistry of Drinking Water Treatment	
Тур	Recitation Section (large)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Dr. Klaus Johannsen
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L0402: Water Resource Management		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Mathias Ernst	
Language	DE	
Cycle	WiSe	
Content	The lecture provides comprehensive knowledge on interaction of water ressource management and drinking water supply. Content	
	overview: • Current situation of global water resources • User and Stakeholder conflicts • Wasserressourcenmanagement in urbane Gebieten • Rechtliche Aspekte, Organisationsformen Trinkwasserversorgungsunternehmen. • Ökobilanzierung, Benchmarking in der Wasserversorgung	
Literature	 Aktuelle UN World Water Development Reports Branchenbild der deutschen Wasserwirtschaft, VKU (2011) Aktuelle Artikel wissenschaftlicher Zeitschriften Ppt der Vorlesung 	

Course L0403: Water Resource Management	
Тур	Recitation Section (small)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Mathias Ernst
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0858: Coast	al Hydraulic Engineering I			
Courses				
Title		Тур	Hrs/wk	СР
Basics of Coastal Engineering (L08)7)	Lecture	3	4
Basics of Coastal Engineering (L14	3)	Project-/problem-based Learning	1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Basics of hydraulic engineering, hydrology and hydrome	chanics		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the	e following learning results		
Professional Competence				
Knowledge	The students are able to define and explain the basic co	ncepts of coastal engineering and port e	ngineering. T	hey are able to apply
	the concepts to selected practical problems of coastal e	engineering. Students can define and de	termine the l	pasics for design an
	dimensioning of coastal engineering constructions.			
Skills	The students are capable to apply basic design approach	nes to selected and pre-defined design ta	asks in coasta	l engineering.
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge	e in applied problems such as the desig	n of coastal p	protection structures
	Additionaly, they will be able to work in team with engin	eers of other disciplines, for instance des	signing of coa	stal breakwaters.
Autonomy	The students will be able to independently extend their l	knowledge and applyit to new problems.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 2 hours. The exam	nination includes tasks with respect to	the general u	understanding of the
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Structural Engineering:	Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineerir	ng: Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Co	mpulsory		
	International Management and Engineering: Specialisation	on II. Civil Engineering: Elective Compuls	ory	

Course L0807: Basics of Coastal Engineering		
Тур	Lecture	
Hrs/wk	3	
CP	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Peter Fröhle	
Language	DE	
Cycle	WiSe	
Content	 Basics of planning and design Water levels Currents Waves Ice Planning and Design in Coastal Engineering Functional and constructional design Determination of design parameters Design-approaches Filter Rubble mound constructions Piles Vertical constructions 	
Literature	Coastal Engineering Manual, CEM	
	Vorlesungsumdruck	

Course L1413: Basics of Coastal Engineering	
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Iodule M0923: Integ	rated Transportation Planning
ourses	
itle	Typ Hrs/wk CP
tegrated Transportation Planning	(L1068) Project-/problem-based Learning 4 6
Module Responsible	Prof. Carsten Gertz
Admission Requirements	None
Recommended Previous	some knowledge of transport planning, e.g. through taking the undergraduate class "Transport Planning and Traffic Engineerin
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to:
	describe interdependencies between land use/location choice and transportation/mobility behaviour
	 describe interdependencies between rand-describe and construction choice and cransportation/mobility behaviour explain and evaluate the social ecological and economic effects of transport and land-use policy measures
	 relate current issues in the area of integrated transport planning and formulate an opinion on them
Skills	Students are able to:
01110	
	 quantify important parameters, which influence travel demand or are influenced by it.
	 comprehensively examine a pre-defined or self-selected topic from a transportation studies perspective and document the
	results in accordance with scientific conventions.
Personal Competence	
Social Competence	Students are able to:
	 provide feedback on topical contents and their teaching.
	constructively handle feedback on their own work.
	 produce results in group work and document these.
Autonomy	Students are able to:
	assess potential consequences of their future professional activities
	• independently plan working on a pre-defined project topic, acquire the necessary knowledge and use appropriate means f
	its execution.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and	written assignment with presentation during the semester
scale	
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory
	Civil Engineering: Specialisation Water and Traffic: Compulsory
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective Compulsory
	Water and Environmental Engineering: Specialisation Water: Elective Compulsory
	Water and Environmental Engineering: Specialisation Environment: Elective Compulsory
	water and Environmental Engineering' Specialisation Cities' Compulsory

Course L1068: Integrated Transportation Planning			
Тур	Project-/problem-based Learning		
Hrs/wk	4		
СР	6		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Lecturer	Prof. Carsten Gertz, Dr. Philine Gaffron, Jacqueline Bianca Maaß		
Language	DE		
Cycle	WiSe		
Content	The course will provide students with an understanding of interdependencies between land-use and transportation. Specific topics		
	 include a.o.: interactions between transport and the environment and consequent limitations characteristics of integrated planning complex planning processes interdependencies of location choice and mobility behaviour transport and land-use policies project on current issues in transportation studies 		
Literature	Kutter, Eckhard (2005) Entwicklung innovativer Verkehrsstrategien für die mobile Gesellschaft. Erich Schmidt Verlag. Berlin. Bracher, Tilman u. a. (Hrsg.) (68. Ergänzung 2013) Handbuch der kommunalen Verkehrsplanung. Herbert Wichmann Verlag. Berlin, Offenbach. (Loseblattsammlung mit kontinuierlichen Ergänzungen)		

Module M0964: Unde	rground Constructions			
Courses				
Title		Тур	Hrs/wk	СР
Applied Tunnel Constructions (L240	07)	Lecture	2	3
Introduction to tunnel construction	(L0707)	Lecture	1	2
Introduction to tunnel construction	(L1811)	Recitation Section (large)	1	1
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous	Modules from Bachelor studies Civil and environmental engineering:			
Knowledge				
	Steel Structures LII			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	Knowledge of different tunnel construction types as well as special methods and techniques of subsoil construction. The students			
	get deeper knowledge of steel and ground engineering as well as constructions knowledge concerning quay walls. Futhermore, the			
	students get all the neccessary knowledge to	design singular construction elements for s	heet pile walls ar	nd they know how to
	choose the right construction elements depending on the influencing conditions.			
Skills	Skills Basic knowledge of tunnel design as well as practical skills in structural tunnel analysis. Furthermore, the students are a			students are able to
	dimension sheet pile wall construction regard	ing all constrution elements, to choose th	e suitable constru	uction elements with
	respect to the influencing conditions, to design	all kinds of sheet pile walls (wave sheet pil	e walls and combi	ned sheet pile walls)
	and to dimension all construction elements and	connections.		
Personal Competence				
Social Competence	Capacity for teamwork concerning project management and design of tunnels.			
Autonomy	Promotion of independent and creative work flo	w in the framework of a design exercise.		
Workload in Hours	Independent Study Time 124, Study Time in Leo	ture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 minutes			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engin	neering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Compulsory			
	Civil Engineering: Specialisation Coastal Engine	ering: Compulsory		
	Civil Engineering: Specialisation Water and Traf	fic: Elective Compulsory		
	International Management and Engineering: Spe	ecialisation II. Civil Engineering: Elective Con	npulsory	

Course L2407: Applied Tunnel Constructions		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Jürgen Grabe, Tim Babendererde	
Language	DE	
Cycle	WiSe	
Content		
Literature		

Course L0707: Introduction to tunnel construction			
Тур	Lecture		
Hrs/wk	1		
СР	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Dr. Marius Milatz		
Language	DE		
Cycle	WiSe		
Content	 Definitions Historical development in tunneling Geology for tunneling Hard rock tunneling (construction composite and machines) Tunnelung in temporarly stable soil with conventional construction methods Tunneling in soft soils (form of supports, shield types, compressed air application) Pipe jacking Tunnel Lining, tunnel supporting structures Calculation approaches for supporting structures in shield-driven tunnels Surveying for tunneling Safety requirements Construction Contract Literature and sources 		
Literature	 Vorlesung/Übung s. www.tu-harburg.de/gbt 		

Course L1811: Introduction to tunnel construction		
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Marius Milatz	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	
Module M0965: Study	v Work Structural Engineering	
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Courses		
Title	Typ Hrs/wk CP	
Module Responsible	Dozenten des SD B	
Admission Requirements	None	
Recommended Previous	Subjects of the Structural Engineering specialisation.	
Knowledge		
Educational Objectives	After taking part successfully, students have reached the following learning results	
Professional Competence		
Knowledge	The students are able to demonstrate their detailed knowledge in the field of structural and construction engineering. They can exemplify the state of technology and application and discuss critically in the context of actual problems and general conditions of science and society.	
	The students can develop solving strategies and approaches for fundamental and practical problems in structural and construction engineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view points of science and society.	
	Scientific work techniques that are used can be described and critically reviewed.	
Skills	The students are able to independently select methods for the project work and to justify this choice. They can explain how these methods relate to the field of work and how the context of application has to be adjusted. General findings and further developments may essentially be outlined.	
Personal Competence		
Social Competence	The students are able to condense the relevance and the structure of the project work, the work steps and the sub-problems for the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to their colleagues.	
Autonomy	The students are capable of independently planning and documenting the work steps and procedures while considering the given deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain feedback from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology.	
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0	
Credit points	6	
Course achievement	None	
Examination	Study work	
Examination duration and scale	see FSPO	
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Compulsory	

Module M0969: Selected Topics in Civil Engineering Courses Title Тур Hrs/wk CP 2 Eraonomics (L0653) Lecture 3 Analysis of Offshore Structures (L1867) Lecture 1 1 Excellence in International Project Delivery (L2387) Integrated Lecture 2 2 Design of Prefabricated Concrete Structures (L0596) Lecture 1 1 Design of Prefabricated Concrete Structures (L0597) Recitation Section (large) 1 1 Forum I - Geotechnics and Construction Management (L1634) Seminar 1 1 Forum II - Geotechnics and Construction Management (L1635) Seminar 1 1 2 3 Geotechnical Engineering Design (L2447) Lecture Timber Structures (L1151) Seminar 2 2 Innovative Timber Construction (L2666) Lecture 2 3 Glass Structures (L1152) Lecture 2 2 Glass Structures (L1447) Recitation Section (large) 1 1 Testing and non-destructive examination of concrete members (L2725) Project-/problem-based Learning 2 2 Special topics of civil engineering 1CP (L2378) 1 1 Special topics of civil engineering 2 LP (L2379) 2 2 Special topics of civil engineering 3 LP (L2380) 3 3 Structural Design (L2789) Seminar 2 2 Module Responsible Prof. Frank Schmidt-Döhl **Admission Requirements** None **Recommended Previous** none Knowledge **Educational Objectives** After taking part successfully, students have reached the following learning results **Professional Competence** Knowledae • Students are able to find their way through selected special areas within civil and structural engineering. • Students are able to explain basic models and procedures in selected special areas of civil and structural engineering. Students are able to interrelate scientific and technical knowledge. Skills • Students are able to apply basic methods in selected areas of civil and structural engineering. **Personal Competence** Social Competence Autonomy • Students can chose independently, in which fields they want to deepen their knowledge and skills through the election of courses. Workload in Hours Depends on choice of courses **Credit points** 6 Assignment for the Civil Engineering: Specialisation Structural Engineering: Elective Compulsory **Following Curricula** Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory

Course L0653: Ergonomics	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and	30 min
scale	
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	

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Course L1867: Analysis of Of	ifshore Structures
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and	30 min
scale	
Lecturer	Dr. Said Fawad Mohammadi
Language	DE/EN
Cycle	SoSe
Content	Topic 1: Types of Offshore Structures, Fixed and floating structures for Oil & Gas and Offshore Wind industry
	Topic 2: Wave Forces, Morisons equation
	Topic 3: Irregular Seastates, Power spectrum and application of FFT
	Topic 4: Additional Environmental Forces, wind spectra, current forces
	Topic 5: Linear-Time-Invariant Systems, response of an LTI-system in frequency domain
	Topic 6: Tubular Welded Connections, stress concentration factors, weld geometry
	Topic 7: Introduction to Fracture Mechanics, criteria for fracture initiation and crack growth
	Topic 8: Time and Frequency Domain Fatigue Analyses, rainflow counting, application of LTI-systems for frequency domain fatigue
	Topic 9: Offshore Installation and Exam, installation of structures, pile driving, pipe laying techniques
Literature	Chakrabarti, Handbook of Offshore Engineering, 2005
	Sarpkaya, Wave Forces on Offshore Structures, 2010
	Faltinsen, Sea Loads on Ships and Offshore Structures, 1998
	Sorensen, Basic Coastal Engineering, 2006
	Dowling, Mechanical Behavior of Materials, 2007
	Haibach, Betriebsfestigkeit, 2006
	Marshall, Design of Welded Tubular Connections, 1992
	Newland, Random vibrations, spectral and wavelet analysis, 1993

Course L2387: Excellence in International Project Delivery	
Тур	Integrated Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	laut FSPO
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt
scale	
Lecturer	Dr. Jens Huckfeldt
Language	EN
Cycle	SoSe
Content	
Literature	

Course L0596: Design of Pre	fabricated Concrete Structures
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and	60 min
scale	
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	SoSe
Content	 application and advantages and disadvantages of precast concrete structures basics of design - precast element production - construction - tolerances elements of a warehouse design of a beam - joints design of D-regions: half joints, corbels, openings slab types - walls - facades footings: pocket and block foundations joints - connections shear design of the interface between concrete cast at different times unreinforced concrete structures
Literature	 Bachmann H., Steinle A.; Hahn V.: Bauen mit Betonfertigteilen. Betonkalender 2009, Teil I, Verlag Ernst & Sohn, Berlin Bindseil P.: Stahlbetonfertigteile. Werner Verlag, 1998 FIP: FIP Handbuch für Planung und Entwerfen von Fertigteilbauten (siehe Zeitschrift: Beton- und Fertigteiltechnik ab 3/1996) Bergmeister K.: Konstruieren von Fertigteilen. Betonkalender 2005 Teil 2, S. 163-240 Reineck KH.: Modellierung der D-Bereiche von Fertigteilen. Betonkalender 2005 Teil 2, S. 241-296 Graubner CA. et. al.: Bemessung von Fertigteilen nach DIN 1045-1. Betonkalender 2005 Teil 2, S. 297-374 Broschüren der Fachvereinigung Deutscher Betonfertigteilbau e.V. siehe: www.fdb-fertigteilbau.de www.systembauweise.de

Course L0597: Design of Prefabricated Concrete Structures	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and	Siehe korrespondierende Vorlesung
scale	
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1634: Forum I - Geotechnics and Construction Management	
Тур	Seminar
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and	30 min
scale	
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	Lectures about projects and issues with practical and scientific relevance.
Literature	

Course L1635: Forum II - Geotechnics and Construction Management	
Тур	Seminar
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and	30 min
scale	
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	SoSe
Content	Lectures about projects and issues with practical and scientific relevance.
Literature	

Course L2447: Geotechnical	Engineering Design
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and	45 Min.
scale	
Lecturer	Prof. Jürgen Grabe, Dr. Tim Pucker
Language	DE
Cycle	WiSe
Content	The focus of the course is on the design of geotechnical structures. Methods and fundamental approaches for the successful
	processing of geotechnical designs are taught. Theoretical approaches are backed up with examples from everyday work in
	industry. In parallel to the theoretical content, students are given a practical task for a geotechnical design at beginning of the
	course, which will be worked on in small teams. In addition to the application of the already acquired technical knowledge, topics
	like realisation, construction sequence planning, cost calculation, optimisation and evaluation criteria are also part of the course.
	The event will be finished with the presentation of the designs.
Literature	

Course L1151: Timber Structures	
Тур	Seminar
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and	90 min
scale	
Lecturer	Prof. Torsten Faber
Language	DE
Cycle	WiSe
Content	
Literature	

Course L2666: Innovative Timber Construction	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and	45 Minuten
scale	
Lecturer	Dr. Andreas Meisel
Language	DE
Cycle	WiSe
Content	
Literature	- Blass, J.: "Ingenieurholzbau"
	- Schickhofer, G.: "BSPhandbuch: Holz-Massivbauweise in Brettsperrholz"
	- Informationsdienst Holz: div. Merkblätter und Broschüren
	- Wallner-Novak M.: Brettsperrholz Bemessung, Band 1 und 2
	- Gerner M.: "Fachwerk: Entwicklung, Instandsetzung, Neubau"
	- Meisel, A.: "Historische Dachwerke: Beurteilung, realitätsnahe statische Analyse und Instandsetzung"
	- Kempe K.: "Dokumentation Holzschädlinge"
	- Huckfeldt T.: "Hausfäule- und Bauholzpilze"

Course L1152: Glass Structures	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and	
scale	
Lecturer	Marvin Matzik
Language	DE
Cycle	WiSe
Content	Glass structures
	- Introduction of the material glass (production, refinement, material characteristic)
	- design of facades
	- facade types
	- static calculation of glazing
	- static calculation of facades
	- load bearing behavior of glazing (plate or membrane stiffness)
	- vertical / horizontal glazing with safety-related requirements
	- glass structures
	- fire safety of glass facades
	- construction physics of facades and glazing
Literature	

Course L1447: Glass Structures				
Тур	Recitation Section (large)			
Hrs/wk				
СР	1			
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14			
Examination Form	Mündliche Prüfung			
Examination duration and				
scale				
Lecturer	Marvin Matzik			
Language	DE			
Cycle	WiSe			
Content	See interlocking course			
Literature	See interlocking course			

Course L2725: Testing and non-destructive examination of concrete members				
Тур	Project-/problem-based Learning			
Hrs/wk				
СР				
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Examination Form	lündliche Prüfung			
Examination duration and	0 min			
scale				
Lecturer	Dr. Lukas Henze, Dr. Lukas Henze			
Language	DE			
Cycle	SoSe			
Content				
Literature				

Course L2378: Special topics of civil engineering 1CP		
Тур		
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Examination Form	laut FSPO	
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt	
scale		
Lecturer	Dozenten des SD B	
Language	DE	
Cycle	WiSe/SoSe	
Content	The course occurs only if required. The content is defined at short notice.	
Literature	Die Literatur wird kurzfristig festgelegt.	

Course L2379: Special topics of civil engineering 2 LP		
Тур		
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	laut FSPO	
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt	
scale		
Lecturer	Dozenten des SD B	
Language	DE	
Cycle	WiSe/SoSe	
Content	The course occurs only if required. The content is defined at short notice.	
Literature	Die Literatur wird kurzfristig festgelegt.	

Course L2380: Special topics of civil engineering 3 LP			
Тур			
Hrs/wk	3		
СР	3		
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42		
Examination Form	laut FSPO		
Examination duration and	rird zu Beginn der Lehrveranstaltung festgelegt		
scale			
Lecturer	Dozenten des SD B		
Language	DE		
Cycle	WiSe/SoSe		
Content	The course occurs only if required. The content is defined at short notice.		
Literature	Die Literatur wird kurzfristig festgelegt.		

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Course L2789: Structural De	sign
Тур	Seminar
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and	20 min
scale	
Lecturer	Dr. Jan Mittelstädt
Language	DE/EN
Cycle	SoSe
Content	
Literature	[1] Structure Systems by Heino Engel, Hantje Cantz, 3rd edition (Feb 2007), ISBN-10: 3775718761
	Form and Force, Designing Efficient, Expressive Structures by Allan, E., Zalewski, W. et al, John Wiley and
	Sons; 1st edition (Sept 2009), ISBN-10: 047017465X
	[2] Peter Rice: An Engineer Imagines, ISBN-10 : 1849944237
	[3] Konrad Wachsmann and the Grapevine Structure by C. Sumi et al., Park Books (Oct 2018), ISBN-10:
	9783038601104
	[4] Manual of Multi-Story Timber Construction by Hermann Kaufmann, Stefan Krotsch, Stefan Winter, DETAIL,
	(June 2018), ISBN-10: 3955533948
	[5] The Art of Structural Design: A Swiss Legacy by B. Billington, Princeton University Art Museum; First Edition
	edition (Mar 2003), ISBN-10: 0300097867
	[6] Structured Lineages: Learning from Japanese Structural Design by G. Nordenson et al, The Museum of
	Modern Art (Jul 2019), ISBN-10: 1633450562
	[7] The Structure: Works of Mahendra Raj by V. Mehta, R. Mehndiretta, A. Huber, Park Books (Oct 2015),
	ISBN-10: 3038600253

Module M0997: Structural Analysis - Selected Topics				
Courses				
Title		Тур	Hrs/wk	СР
Plates and Shells (L1199)		Lecture	2	2
Nonlinear Analysis of Frame Structu	ure (L1200)	Lecture	2	2
Nonlinear Analysis of Frame Structu	ure (L1201)	Recitation Section (large)	2	2
Module Responsible	Prof. Uwe Starossek			
Admission Requirements	None			
Recommended Previous	Mechanics I/II, Mathematics I/II, Differential Equations I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	After successful completion of this module, students can expla	in selected elements of higher str	uctural analysis	5.
Skills				
	After successful completion of this module, the students are	able to assess the premises and	the applicabili	ity of the presented
	methods of advanced structural analysis. They are able to use	these methods for performing str	uctural analyse	·S.
Personal Competence				
Social Competence	Students can			
	 participate in subject-specific and interdisciplinary discu 	ssions,		
	defend their own work results in front of others			
	Europhone they can give and accept professional con-	structivo criticiam		
	• Furthermore, they can give and accept professional con-	structive childism		
Autonomy	The students have the opportunity to voluntarily and independ	ently work homework problems.		
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	135 min			
scale	1.22 (1)(1)			
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Electiv	e Compulsory		
Following Curricula	Civil Engineering: Specialisation Gentechnical Engineering: Electiv	ctive Compulsory		
i onowing curricula	Civil Engineering: Specialisation Coastal Engineering: Elective (Compulsory		
	con Engineering, specialisation coustal Engineering. Elective (

Course L1199: Plates and Sh	ells			
Тур	Lecture			
Hrs/wk	2			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Dr. Jürgen Priebe			
Language	DE			
Cycle	WiSe			
Content	Theory of plates loaded in-plane			
	 Governing equations (equilibrium, kinematics, constitutive law) Differential equation Airy stress function Plane stress / plane strain Structural behaviour of plates loaded in-plane Theory of plates in bending Governing equations (equilibrium, kinematics, constitutive law) Differential equation Navier solution / Fourier series expansion Approximation procedures Structural behaviour of plates in bending Shell theory Phenomenona of the structural behaviour of shells Membrane and bending theory Equilibrium equations of shells of revolution Stress resultants and deformations of the spherical shell, the half spherical shell, and the cylindrical shell Stability problems (overview) 			
	Shell buckling			
Literature	 Basar, Y.: Krätzig, W.B. (1985): Mechanik der Flächentragwerke. Vieweg-Verlag, Braunschweig, Wiesbaden Girkmann, K. (1963): Flächentragwerke, Springer Verlag, Wien, 1963, unveränderter Nachdruck 1986 Zienkiewicz, O.C. (1977): The Finite Element Method in Enginieering Science. McGraw-Hill, London 			

Course L1200: Nonlinear Ana	Ilysis of Frame Structure
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	WiSe
Content	-Types of nonlinearity
	-relevance of nonlinear effects on structural analysis
	-comparison and classification of 1 st order theory, 2 nd order theory and 3 rd order theory with regard to the coverage of geometric nonlinearity
	-fundamentals of 2 nd order elasticity theory for frame structures
	-application of 2 nd order elasticity theory using finite elements: common displacement method
	-fundamentals of analytical application of 2 nd order elasticity theory: derivation and solution of differential equation
	-structurally applied methods of analytical application of 2 nd order elasticity theory: common displacement method using analytical stiffness matrix, slope-deflection method for sway and non-sway frame structures, consideration of imperfections
	1 st order plastic hinge theory
Literature	Rothert, H.; Gensichen, V. (1987): Nichtlineare Stabstatik. Springer Verlag, Berlin

Course L1201: Nonlinear Analysis of Frame Structure		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Uwe Starossek	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M1505: Adap	ation to Climate (Change in Hydraul	ic Engineering (AKWAS)		
Courses					
Title Adaptation to climate change in hy	draulic engineering (L2291)		Typ Project-/problem-based Learning	Hrs/wk 4	CP 6
Module Responsible	Prof. Peter Fröhle				
Admission Requirements	None				
Recommended Previous Knowledge	 Hydrology, Hydrau Hydromechanic, Hy Fundamentals of C Hydrological System 	ic Engineering rdraulics pastal Engineering, Coastal ms	- and Flood Protection		
Educational Objectives	After taking part successf	ully, students have reached	d the following learning results		
Professional Competence					
Knowledge Skills	 Climate protection Insights into climate Impacts of climate Fundamentals of an Consequences of th Measures for climate Assessment, priorith Fundamentals of th Critical thinking: ar Creative thinking: methods Consideration of consideration of consi	and climate adaptation e change and its regional c change on the components halysis of climate data ne impact of the climate ch te adaptation ization and communication re analysis of hydrometeoro halysis of processes and rel development of adaptation inclusion of restrictions, a mplex tasks	haracteristics - fundamentals, climate mode s of the regional hydrological cycle ange of adaptation measures ological and hydrological data ations, assessment of needs for action strategies and adaptation measures application of calculation approaches, meth	lling / climate	models al models, planning
Personal Competence Social Competence	Working in heterogWorking with differSelf reflection	enous groups ent scientific / non-scientifi	c disciplines		
Autonomy	 Application oriente Autonomous work or	d use of knowledge and ski on complex tasks	lls		
Workload in Hours	Independent Study Time	124, Study Time in Lecture	56		
Credit points	6				
Course achievement	None				
Examination	Written elaboration				
Examination duration and	Preparation of a written re	eport and a presentation of	a complex task.		
scale					
Assignment for the Following Curricula	Civil Engineering: Special Civil Engineering: Special Civil Engineering: Special Civil Engineering: Special	sation Coastal Engineering sation Geotechnical Engine sation Structural Engineeri sation Water and Traffic: E	: Elective Compulsory eering: Elective Compulsory ng: Elective Compulsory lective Compulsory		
	Water and Environmental Water and Environmental Water and Environmental	Engineering: Specialisation Engineering: Specialisation Engineering: Specialisation	n Cities: Elective Compulsory n Environment: Elective Compulsory n Water: Elective Compulsory		

Course L2291: Adaptation to	climate change in hydraulic engineering				
Тур	Project-/problem-based Learning				
Hrs/wk	4				
СР	6				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Lecturer	Prof. Peter Fröhle				
Language	DE				
Cycle	WiSe				
Content	 Climate protection and climate adaptation Findings on climate change and its regional characteristics: fundamentals of climate change, climate modelling / climate models Impacts of climate change on the components of the regional hydrological cycle(climate science view) Fundamentals of the analysis of climate data Concequences of the impacts of climate change (ingenieering science view) Measures for climate change adaptation Assessment, prioritization and communication of measures Fundamentals of analysis of hydrometeorological and hydrological data 				
Literature	Bereitgestellte eLearning Plattform				

Module M1725: Scien	tific Working in Computational E	ngineering		
Courses				
Title		Тур	Hrs/wk	СР
Scientific Working in Computationa	l Engineering (L2764)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None			
Recommended Previous	Basic knowledge in scientific writing. String interest in topics related to computing in civil engineering.			
Knowledge				
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
	course instructors and in collaboration with each other, the students will also learn to understand the complex process of scientific thinking, being able to accurately plan, implement and analyze scientific projects, such as prospective master theses. Since scientific writing is of particular importance in this course, a scientific paper will be developed, which is a prerequisite for the final examination. The paper will be written based on a project to be conducted within this course. Project meetings in small groups, presentations, and critical discussions of scientific publications are further key activities.			
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lec	ture 56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	10 pages of work with 15-minute oral presentati	on		
scale				
Assignment for the	Civil Engineering: Specialisation Water and Traff	c: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Er	gineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Enginee	ring: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engin	eering: Elective Compulsory		

Course L2764: Scientific Wor	king in Computational Engineering
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Kay Smarsly
Language	EN
Cycle	WiSe/SoSe
Content	In the course, a scientific problem of practical relevance will first be defined, taking into account the interests of the students participating in the course. The scientific problem will then systematically be solved within the framework of a comprehensive project. The principles of scientific working will be taught based on the scientific problem defined previously. As an integral part of scientific working, fundamentals of scientific writing will be presented and applied to a scientific paper to be written during the course. Topics related to scientific writing include structuring in scientific writing (structuring the abstract, the introduction, the main part, the summary and conclusions, and the acknowledgments and references) and recommendations on effective scientific writing (principles of composition use of English in scientific writing useful tips creating figures writing in mathematics
Literature	referencing, and formal email correspondence). A final paper and a final presentation will be assembled by the students.

Module M1/24: Smar	t Monitoring			
Courses				
Title		Тур	Hrs/wk	СР
Smart Monitoring (L2762)		Integrated Lecture	2	2
Smart Monitoring (L2763)		Recitation Section (small)	2	4
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None			
Recommended Previous	Basic knowledge or interest in object-oriented modeling,	programming, and sensor technol	ogies are helpfu	I. Interest in moderr
Knowledge	research and teaching areas, such as Internet of Things, I	ndustry 4.0 and cyber-physical sy	/stems, as well a	as the will to deepen
	skills of scientific working, are required. Basic knowledge in	scientific writing and good English	ı skills.	
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence				
Knowledge	The students will become familiar with the principles an	d practices of smart monitoring.	The students w	ill be able to design
	decentralized smart systems to be applied for continuc	ous (remote) monitoring of syste	ems in the built	and in the natura
	environment. In addition, the students will learn to design	and to implement intelligent sense	or systems using	state-of-the-art data
	analysis techniques, modern software design concepts, and	l embedded computing methodolo	gies. Besides lec	tures, project work is
	also part of this module. In small groups, the students	s will design smart monitoring s	ystems that int	egrate a number of
	"intelligent" sensors to be implemented by the students	s. Specific focus will be put on	the application	of machine learning
	techniques. The smart monitoring systems will be mounted	d on real-world (built or natural) s	ystems, such as	bridges or slopes, or
	on scaled lab structures for validation purposes. The outco	ome of every group will be docum	ented in a pape	r. All students of this
	module will "automatically" participate with their smart r	monitoring system in the annual	"Smart Monitorii	ng" competition. The
	whiten papers and oral examinations form the final grades.	. The module will be taught in Engl	ish. Limited enro	iiment.
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	10 pages of work with 15-minute oral presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Water and Traffic: Elective	Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering:	Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Electi	ve Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Ele	ctive Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Electi	ve Compulsory		
	Civil Engineering: Specialisation Geotechnical Engineering:	Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Ele			
	Environmental Engineering: Specialisation Water and Hame. Elective	v: Elective Compulsory		
	Environmental Engineering: Specialisation Riotechnology: F	elective Compulsory		
	Environmental Engineering: Specialisation Water: Elective (Compulsory		
	Environmental Engineering: Specialisation Waste and Energy	ay: Elective Compulsory		
	Environmental Engineering: Specialisation Biotechnology: E	lective Compulsory		
	Environmental Engineering: Specialisation Water: Elective (Compulsory		
	Water and Environmental Engineering: Specialisation Cities	: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Cities	: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Enviro	onment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Enviro	onment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Water	r: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Water	r: Elective Compulsory		

Course L2762: Smart Monito	ring
Тур	Integrated Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Kay Smarsly
Language	EN
Cycle	WiSe/SoSe
Content	In this course, principles of smart monitoring will be taught, focusing on modern concepts of data acquisition, data storage, and data analysis. Also, fundamentals of intelligent sensors and embedded computing will be illuminated. Autonomous software and decentralized data processing are further crucial parts of the course, including concepts of the Internet of Things, Industry 4.0 and cyber-physical systems. Furthermore, measuring principles, data acquisition systems, data management and data analysis algorithms will be discussed. Besides the theoretical background, numerous practical examples will be shown to demonstrate how smart monitoring may advantageously be used for assessing the condition of systems in the built or natural environment.
Literature	

Course L2763: Smart Monitoring		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	4	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28	
Lecturer	Prof. Kay Smarsly	
Language	EN	
Cycle	WiSe/SoSe	
Content	The contents of the exercises are based on the lecture contents. In addition to the exercises, project work will be conducted, which will consume the majority of the workload. As part of the project work, students will design smart monitoring systems that will be tested in the laboratory or in the field. As mentioned in the module description, the students will participate in the "Smart Monitoring" competition, hosted annually by the Institute of Digital and Autonomous Construction. Students are encouraged to contribute their own ideas. The tools required to implement the smart monitoring systems will be taught in the group exercises as well as through external sources, such as video tutorials and literature.	
Literature		

Specialization Water and Traffic

Module M0964: Underground Constructions				
Courses				
Title		Тур	Hrs/wk	СР
Applied Tunnel Constructions (L24)	07)	Lecture	2	3
Introduction to tunnel construction	(L0707)	Lecture	1	2
Introduction to tunnel construction	(L1811)	Recitation Section (large)	1	1
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous	Modules from Bachelor studies Civil and environment	al engineering:		
Knowledge	Geotechnics I-II			
	Steel Structures I-II			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	Knowledge of different tunnel construction types as	well as special methods and technique	s of subsoil constr	uction. The students
	get deeper knowledge of steel and ground engineering	ng as well as constructions knowledge c	oncerning quay w	alls. Futhermore, the
	students get all the neccessary knowledge to desig	n singular construction elements for s	heet pile walls an	d they know how to
	choose the right construction elements depending on	the influencing conditions.		
Skills	Basic knowledge of tunnel design as well as practical skills in structural tunnel analysis. Furthermore, the students are able to			
	dimension sheet pile wall construction regarding a	Il constrution elements, to choose the	suitable constru	ction elements with
	respect to the influencing conditions, to design all ki	nds of sheet pile walls (wave sheet pile	e walls and combine	ned sheet pile walls)
	and to dimension all construction elements and conn	ections.		
Personal Competence				
Social Competence	Capacity for teamwork concerning project manageme	ent and design of tunnels.		
Autonomy	Promotion of independent and creative work flow in t	he framework of a design exercise.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 minutes			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineerir	ig: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engine	ering: Compulsory		
	Civil Engineering: Specialisation Coastal Engineering:	Compulsory		
	Civil Engineering: Specialisation Water and Traffic: El	ective Compulsory		
	International Management and Engineering: Specialis	ation II. Civil Engineering: Elective Com	pulsory	

Course L2407: Applied Tunnel Constructions	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Jürgen Grabe, Tim Babendererde
Language	DE
Cycle	WiSe
Content	
Literature	

Course L0707: Introduction t	to tunnel construction
Тур	Lecture
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Dr. Marius Milatz
Language	DE
Cycle	WiSe
Content	 Definitions Historical development in tunneling Geology for tunneling Hard rock tunneling (construction composite and machines) Tunnelung in temporarly stable soil with conventional construction methods Tunneling in soft soils (form of supports, shield types, compressed air application) Pipe jacking Tunnel Lining, tunnel supporting structures Calculation approaches for supporting structures in shield-driven tunnels Surveying for tunneling
Literature	 Safety requirements Construction Contract Literature and sources Vorlesung/Übung s. www.tu-harburg.de/gbt

Course L1811: Introduction to tunnel construction	
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Marius Milatz
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0595: Exam	ination of Materials, Structural Cor	dition and Damages		
Courses				
Title		Тур	Hrs/wk	СР
Examination of Materials, Structura	ll Condition and Damages (L0260)	Lecture	3	4
Examination of Materials, Structura	I Condition and Damages (L0261)	Recitation Section (small)	1	2
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous	Basic knowledge about building materials or ma	aterial science, for example by the mod	ule Building M	aterials and Building
Knowledge	Chemistry.			
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge	The students are able to describe the rules for tra methods for the testing of building material proper testing methods.	ding, use and marking of construction pro ties are usable and know the limitations an	ducts in Germa d characterics	any. They know which of the most important
Skills	The students are able to responsibly discover the ru They are able to chose suitable methods for the te the examination of the structural conditions of buil are able to describe an examination in form of a te	ules for trading and using of building produ- sting and inspection of construction produc dings. They are able to conclude from symp st report or expert opinion.	cts in Germany. cts, the examina otons to the car	ation of damages and use of damages. They
Personal Competence Social Competence	The students can describe the different roles of m framework of material testing. They can describe th	anufacturers as well as testing, supervisor ne different roles of the participants in legal	y and certificat proceedings.	tion bodies within the
Autonomy	The students are able to make the timing and the o	peration steps to learn the specialist knowl	edge of a very	extensive field.
Workload in Hours	Independent Study Time 124, Study Time in Lectur	e 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Enginee	ring: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engir	eering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineerin	g: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic:	Elective Compulsory		
	International Management and Engineering: Specia	lisation II. Civil Engineering: Elective Comp	ulsory	
	Materials Science: Specialisation Engineering Mater	ials: Elective Compulsory		

Course L0260: Examination of	of Materials, Structural Condition and Damages
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Frank Schmidt-Döhl
Language	DE
Cycle	WiSe
Content	Materials testing and marking process of construction products, testing methods for building materials and structures, testing
	reports and expert opinions, describing the condition of a structure, from symptons to the cause of damages
Literature	Frank Schmidt-Döhl: Materialprüfung im Bauwesen. Fraunhofer irb-Verlag, Stuttgart, 2013.

Course L0261: Examination of Materials, Structural Condition and Damages	
Тур	Recitation Section (small)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Frank Schmidt-Döhl
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

vodule M0923: Integ	
Courses	
itle	Typ Hrs/wk CP
ntegrated Transportation Planning	(L1068) Project-/problem-based Learning 4 6
Module Responsible	Prof. Carsten Gertz
Admission Requirements	None
Recommended Previous	some knowledge of transport planning, e.g. through taking the undergraduate class "Transport Planning and Traffic Engineerin
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to:
	describe interdependencies between land-use/location choice and transportation/mobility behaviour
	 explain and evaluate the social, ecological and economic effects of transport and land-use policy measures.
	• relate current issues in the area of integrated transport planning and formulate an opinion on them.
Chille	Chudadh an abla ta
SKIIIS	Students are able to:
	 quantify important parameters, which influence travel demand or are influenced by it.
	• comprehensively examine a pre-defined or self-selected topic from a transportation studies perspective and document the
	results in accordance with scientific conventions.
Personal Competence	
Social Competence	Students are able to:
	 provide reedback on topical contents and their teaching.
	constructively handle feedback on their own work.
	 produce results in group work and document these.
Autonomy	Students are able to:
	assess potential consequences of their future professional activities
	 independently plan working on a pre-defined project topic, acquire the necessary knowledge and use appropriate means f
	its execution.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and	written assignment with presentation during the semester
scale	
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory
	Civil Engineering: Specialisation Water and Traffic: Compulsory
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective Compulsory
	Water and Environmental Engineering: Specialisation Water: Elective Compulsory
	Water and Environmental Engineering: Specialisation Environment: Elective Compulsorv
	Weter and Environmental Environment Environmental Environmental

Course L1068: Integrated Tr	ansportation Planning
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Carsten Gertz, Dr. Philine Gaffron, Jacqueline Bianca Maaß
Language	DE
Cycle	WiSe
Content	The course will provide students with an understanding of interdependencies between land-use and transportation. Specific topics
	 include a.o.: interactions between transport and the environment and consequent limitations characteristics of integrated planning complex planning processes interdependencies of location choice and mobility behaviour transport and land-use policies project on current issues in transportation studies
Literature	Kutter, Eckhard (2005) Entwicklung innovativer Verkehrsstrategien für die mobile Gesellschaft. Erich Schmidt Verlag. Berlin. Bracher, Tilman u. a. (Hrsg.) (68. Ergänzung 2013) Handbuch der kommunalen Verkehrsplanung. Herbert Wichmann Verlag. Berlin, Offenbach. (Loseblattsammlung mit kontinuierlichen Ergänzungen)

Module M0801: Wate	r Resources and -Supply				
Courses					
Title		Тур	Hrs/wk	СР	
Chemistry of Drinking Water Treat	ment (L0311)	Lecture	2	1	
Chemistry of Drinking Water Treat	ment (L0312)	Recitation Section (large)	1	2	
Water Resource Management (L04	02)	Lecture	2	2	
Water Resource Management (L04	03)	Recitation Section (small)	1	1	
Module Responsible	Prof. Mathias Ernst				
Admission Requirements	None				
Recommended Previous	Knowledge of water management and the key pro-	cesses involved in water treatment.			
Knowledge					
Educational Objectives	After taking part successfully, students have reach	ed the following learning results			
Professional Competence					
Knowleage	Students will be able to outline key areas of conflict in water management, as well as their mutual dependence for sustainable water supply. They will understand relevant economic, environmental and social factors. Students will be able to explain and outline the organisational structures of water companies. They will be able to explain the available water treatment processes and the scope of their application.				
Skills	Students will be able to assess complex problems in drinking water production and establish solutions involving water management and technical measures. They will be able to assess the evaluation methods that can be used for this. Students will be able to carry out chemical calculations for selected treatment processes and apply generally accepted technical rules and standards to these processes.				
Personal Competence					
Social Competence	Working in a diverse group of specialists, students will be able to develop and document complex solutions for the management and treatment of drinking water. They will be able to take an appropriate professional position, for example representing user interests. They will be able to develop joint solutions in teams of diverse experts and present these solutions to others.				
Autonomy		ndependentry and present on this subject.			
Workload in Hours	Independent Study Time 96, Study Time in Lecture	. 84			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	60 min (chemistry) + presentation				
scale					
Assignment for the	Civil Engineering: Specialisation Structural Enginee	ring: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engi	neering: Elective Compulsory			
	Civil Engineering: Specialisation Water and Traffic:	Compulsory			
	vil Engineering: Specialisation Coastal Engineering: Elective Compulsory				
	Energy and Environmental Engineering: Specialisation Energy and Environmental Engineering: Elective Compulsory				
	International Management and Engineering: Specialisation II. Energy and Environmental Engineering: Elective Compulsory				
Water and Environmental Engineering: Specialisation Water: Compulsory					
	Water and Environmental Engineering: Specialisati	on Environment: Elective Compulsory			
	Water and Environmental Engineering: Specialisat	on Cities: Elective Compulsory			

Course L0311: Chemistry of	Drinking Water Treatment
Тур	Lecture
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dr. Klaus Johannsen
Language	DE
Cycle	WiSe
Content	The topic of this course is water chemistry with respect to drinking water treatment and water distribution
	Major topics are solubility of gases, carbonic acid system and calcium carbonate, blending, softening, redox processes, materials and legal requirements on drinking water treatment. Focus is put on generally accepted rules of technology (DVGW- and DIN- standards). Special emphasis is put on calculations using realistic analysis data (e.g. calculation of pH or calcium carbonate dissolution potential) in exercises. Students can get a feedback and gain extra points for exam by solving problems for homework. Knowledge of drinking water treatment processes is vital for this lecture. Therefore the most important processes are explained coordinated with the course " Water resources management" in the beginning of the semester.
Literature	 MHW (rev. by Crittenden, J. et al.): Water treatment principles and design. John Wiley & Sons, Hoboken, 2005. Stumm, W., Morgan, J.J.: Aquatic chemistry. John Wiley & Sons, New York, 1996. DVGW (Hrsg.): Wasseraufbereitung - Grundlagen und Verfahren. Oldenbourg Industrie Verlag, München, 2004. Jensen, J. N.: A Problem Solving Approach to Aquatic Chemistry. John Wiley & Sons, Inc., New York, 2003.

Course L0312: Chemistry of Drinking Water Treatment	
Тур	Recitation Section (large)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Dr. Klaus Johannsen
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L0402: Water Resource Management		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Mathias Ernst	
Language	DE	
Cycle	WiSe	
Content	The lecture provides comprehensive knowledge on interaction of water ressource management and drinking water supply. Content	
	overview: • Current situation of global water resources • User and Stakeholder conflicts • Wasserressourcenmanagement in urbane Gebieten • Rechtliche Aspekte, Organisationsformen Trinkwasserversorgungsunternehmen. • Ökobilanzierung, Benchmarking in der Wasserversorgung	
Literature	 Aktuelle UN World Water Development Reports Branchenbild der deutschen Wasserwirtschaft, VKU (2011) Aktuelle Artikel wissenschaftlicher Zeitschriften Ppt der Vorlesung 	

Course L0403: Water Resour	rce Management		
Тур	Recitation Section (small)		
Hrs/wk	1		
CP 1			
Workload in Hours Independent Study Time 16, Study Time in Lecture 14			
Lecturer	Prof. Mathias Ernst		
Language DE			
Cycle	WiSe		
Content	Content See interlocking course		
Literature	See interlocking course		

Module M0830: Enviro	onmental Protection and Managen	nent		
Courses				
Title Integrated Pollution Control (L0502)	Тур Lecture	Hrs/wk 2	CP 2
Health, Safety and Environmental M	Management (L0387)	Lecture	2	3
Medule Deepensible	Prof. Bolf Ottorpobl	Recitation Section (small)	1	I
Admission Requirements				
Recommended Previous				
Knowledge	 Good knowledge in Technologies for Environ Good knowledge of the relevant Environme Basic knowledge of instruments for Environ 	nmental Protection (end-of-pipe, integrate ntal Legislation mental Assessment	d solutions)	
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
Professional Competence Knowledge	The students are able to describe the basics of regulations, economic instruments, voluntary initiatives, fundamentals of HSE legislation ISO 14001, EMAS and Responsible Care ISO 14001 requirements. They can analyse and discuss industrial processes, substance cycles and approaches from end-of-pipe technology to eco-efficiency and eco-effectiveness, showing their sound knowledge of complex industry related problems. They are able to judge environmental issues and to widely consider, apply or carry out innovative technical solutions, remediation measures and further interventions as well as conceptual problem solving approaches in the full range of problems in different industrial sectors.			
Skills	Students are able to assess current problems and situations in the field of environmental protection. They can consider the best available techniques and to plan and suggest concrete actions in a company- or branch-specific context. By this means they can solve problems on a technical, administrative and legislative level.			
Personal Competence				
Social Competence	The students can work together in international gr	oups.		
Autonomy	Students are able to organize their work flow to prepare themselves for presentations and contributions to the discussions. They can acquire appropriate knowledge by making enquiries independently.			
Workload in Hours	Independent Study Time 110, Study Time in Lectu	re 70		
Credit points	6			
Course achievement	None			
Examination	written exam			
Examination duration and				
Assignment for the	Civil Engineering: Specialisation Water and Traffic	Elective Compulsory		
Following Curricula	Bioprocess Engineering: Specialisation Vater and Halle	economic Process Engineering, Focus N	lanagement and	Controlling: Elective
	Compulsory Energy and Environmental Engineering: Specialisa Environmental Engineering: Core Qualification: Co Joint European Master in Environmental Studies - C Joint European Master in Environmental Studies - C Product Development, Materials and Production: S Product Development, Materials and Production: S Product Development, Materials and Production: S Water and Environmental Engineering: Specialisat Water and Environmental Engineering: Specialisat	tion Environmental Engineering: Elective mpulsory Cities and Sustainability: Specialisation Wa Cities and Sustainability: Specialisation En pecialisation Product Development: Electi pecialisation Production: Elective Compuls pecialisation Materials: Elective Compulsor ion Environment: Compulsory ion Cities: Compulsory	Compulsory ater: Elective Comp ergy: Elective Com ve Compulsory sory ry	pulsory Ipulsory

Course L0502: Integrated Po	Ilution Control
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	WiSe
Content	The lecture focusses on: The Regulatory Framework Pollution & Impacts, Characteristics of Pollutants Approaches of Integrated Pollution Control Sevilla Process, Best Available Technologies & BREF Documents Case Studies: paper industry, cement industry, automotive industry Field Trip
Literature	Förstner, Ulrich (1998): Integrated Pollution Control, Springer-Verlag Berlin Heidelberg, ISBN 978-3-642-80313-0 Shen, Thomas T. (1999): Industrial Pollution Prevention, Springer-Verlag Berlin Heidelberg, ISBN 978-3-540-65208-3

Course L0387: Health, Safety	y and Environmental Management
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Hans-Joachim Nau
Language	EN
Cycle	WiSe
Content	 Objectives of and benefit from HSE management From dilution and end-of-pipe technology to eco-efficiency and eco-effectiveness Behaviour control: regulations, economic instruments and voluntary initiatives Fundamentals of HSE legislation ISO 14001, EMAS and Responsible Care ISO 14001 requirements Environmental performance evaluation Risk management: hazard, risk and safety Health and safety at the workplace Crisis management
Literature	C. Stephan: Industrial Health, Safety and Environmental Management, MV-Verlag, Münster, 2007/2012 (can be found in the library under GTG 315) Exercises can be downloaded from StudIP

Course L0388: Health, Safety	y and Environmental Management
Тур	Recitation Section (small)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Hans-Joachim Nau
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M0902: Wast	ewater Treatment and Air Po	Ilution Abatement		
Courses				
Title		ανΤ	Hrs/wk	СР
Biological Wastewater Treatment (L0517)	Lecture	2	3
Air Pollution Abatement (L0203)		Lecture	2	3
Module Responsible	Dr. Swantje Pietsch-Braune			
Admission Requirements	None			
Recommended Previous	Basic knowledge of biology and chemistry	/		
Knowledge				
-	basic knowledge of solids process enginee	ering and separation technology		
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
Knowledge	After successful completion of the module	e students are able to		
	 name and explain biological proce 	assas for waste water treatment		
	 hame and explain biological process characterize waste water and sews 	age sludge		
	discuss legal regulations in the are	a of emissions and air quality		
	 discuss legal regulations in the area classify off as tratament processe 	a of emissions and an quanty		
	• classify on gas cretament processe	s and to define their area of application		
Skills	Students are able to			
	• change and design processes stored	for the biological waste water treatment		
	combine processes for cleaning of	off gases depending on the pollutants contain	and in the gases	
	• combine processes for cleaning of	on-gases depending on the pollutants contain	ieu in the gases	
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Water an	d Traffic: Elective Compulsory		
Following Curricula	Bioprocess Engineering: Specialisation A -	- General Bioprocess Engineering: Elective Co	mpulsory	
	Chemical and Bioprocess Engineering: Sp	ecialisation General Process Engineering: Ele	ctive Compulsory	
	Energy and Environmental Engineering: Specialisation Environmental Engineering: Elective Compulsory			
	Environmental Engineering: Specialisation Waste and Energy: Elective Compulsory			
	International Management and Engineering: Specialisation II. Energy and Environmental Engineering: Elective Compulsory			
	Joint European Master in Environmental Studies - Cities and Sustainability: Specialisation Water: Elective Compulsory			
	Renewable Energies: Specialisation Bioenergy Systems: Elective Compulsory			
	Process Engineering: Specialisation Enviro	onmental Process Engineering: Elective Comp	oulsory	
	Process Engineering: Specialisation Proce	ss Engineering: Elective Compulsory		
	Water and Environmental Engineering: Sp	pecialisation Water: Elective Compulsory		
	Water and Environmental Engineering: Sp	pecialisation Environment: Compulsory		
	Water and Environmental Engineering: Sc	pecialisation Cities: Compulsory		

Course L0517: Biological Wastewater Treatment		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Dr. Joachim Behrendt	
Language	DE/EN	
Cycle	WiSe	
Content	Charaterisation of Wastewater	
	Metobolism of Microorganisms	
	Kinetic of mirobiotic processes	
	Calculation of bioreactor for wastewater treatment	
	Concepts of Wastewater treatment	
	Design of WWTP	
	Excursion to a WWTP	
	Biofilms	
	Biofim Reactors	
	Anaerobic Wastewater and sldge treatment	
	resources oriented sanitation technology	
	Future challenges of wastewater treatment	

Literature	Gujer, Willi
	Siedlungswasserwirtschaft : mit 84 Tabellen
	ISBN: 3540343296 (Gb.) URL: http://www.gbv.de/dms/bs/toc/516261924.pdf URL: http://deposit.d-nb.de/cgi-bin/dokserv?
	id=2842122&prov=M&dok_var=1&dok_ext=htm
	Berlin [u.a.] : Springer, 2007
	TUB_HH_Katalog
	Henze, Mogens
	Wastewater treatment : biological and chemical processes
	ISBN: 3540422285 (Pp.)
	Berlin [u.a.] : Springer, 2002
	TUB_HH_Katalog
	Imhoff, Karl (Imhoff, Klaus R.;)
	Taschenbuch der Stadtentwässerung : mit 10 Tafeln
	ISBN: 3486263331 ((Gb.))
	München [u.a.] : Oldenbourg, 1999
	TUB_HH_Katalog
	Lange, Jörg (Otterpohl, Ralf; Steger-Hartmann, Thomas;)
	Abwasser : Handbuch zu einer zukunftsfähigen Wasserwirtschaft
	ISBN: 3980350215 (kart.) URL: http://www.gbv.de/du/services/agi/52567E5D44DA0809C12570220050BF25/000000700334
	Donaueschingen-Pfohren : Mall-Beton-Verl., 2000
	TUB_HH_Katalog
	Mudrack, Klaus (Kunst, Sabine;)
	Biologie der Abwasserreinigung : 18 Tabellen
	ISBN: 382741427X URL: http://www.gbv.de/du/services/agi/94B581161B6EC747C1256E3F005A8143/420000114903
	Heidelberg [u.a.] : Spektrum, Akad. Verl., 2003
	TUB_HH_Katalog
	Tchobanoglous, George (Metcalf & Eddy, Inc., ;)
	Wastewater engineering : treatment and reuse
	ISBN: 0070418780 (alk. paper) ISBN: 0071122508 (ISE (*pbk))
	Boston [u.a.] : McGraw-Hill, 2003
	IUB_HH_Katalog
	Henze, Mogens
	ACTIVATED STUDIES ASM1, ASM2, ASM20 and ASM3
	ISBN: 1900222248
	Rauhaus-Universität Arheitsgrunne Weiterhildendes Studium Wasser und Umwelt (Deutsche Vereinigung für
	Wasserwirtschaft Abwasser und Abfall -)
	Abwasserbehandlung · Gewässerbelastung, Bemessungsgrundlagen, Mechanische Verfahren, Biologische Verfahren, Beststoffe
	aus der Abwasserbehandlung. Kleinkläranlagen
	ISBN: 3860682725 URL: http://www.gbv.de/dms/weimar/toc/513989765_toc.pdf URL:
	http://www.gbv.de/dms/weimar/abs/513989765 abs.pdf
	Weimar : Universitätsverl, 2006
	TUB HH Katalog
	Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall
	DWA-Regelwerk
	Hennef : DWA, 2004
	TUB_HH_Katalog
	Wiesmann, Udo (Choi, In Su; Dombrowski, Eva-Maria;)
	Fundamentals of biological wastewater treatment
	ISBN: 3527312196 (Gb.) URL: http://deposit.ddb.de/cgi-bin/dokserv?id=2774611&prov=M&dok_var=1&dok_ext=htm
	Weinheim : WILEY-VCH, 2007
	TUB_HH_Katalog

Course L0203: Air Pollution A	Abatement
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Swantje Pietsch-Braune
Language	EN
Cycle	WiSe
Content	In the lecture methods for the reduction of emissions from industrial plants are treated. At the beginning a short survey of the different forms of air pollutants is given. In the second part physical principals for the removal of particulate and gaseous pollutants form flue gases are treated. Industrial applications of these principles are demonstrated with examples showing the removal of specific compounds, e.g. sulfur or mercury from flue gases of incinerators.
Literature	Handbook of air pollution prevention and control, Nicholas P. Cheremisinoff Amsterdam [u.a.] : Butterworth-Heinemann, 2002 Atmospheric pollution : history, science, and regulation, Mark Zachary Jacobson Cambridge [u.a.] : Cambridge Univ. Press, 2002 Air pollution control technology handbook, Karl B. Schnelle Boca Raton [u.a.] : CRC Press, c 2002 Air pollution, Jeremy Colls 2. ed London [u.a.] : Spon, 2002

Module M0826: Biolog	gy, Geology and Chemistry			
Courses				
Title		Тур	Hrs/wk	СР
Biology (L1428)		Lecture	2	2
Geology and Soil Science (L0903)		Lecture	2	1
Environmental Analysis (L0354)		Lecture	2	3
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
Recommended Previous	Fundamentals of inorganic/organic che	mistry and biology (knowledge acquired at schoo	ol)	
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge	With the completion of this module students acquire profound knowledge of the geo- and pedosphere, biogeochemical processes			
_	and the fate of migrating compounds in	n soil and groundwater. They learn about method	ds to investigate sites f	or different use.
			-	
Skills	With the completion of this module students can apply the acquired theoretical knowledge to model sites and assess the situation			
	technically and conceptually. They are	e able to draw comparisons on different inves	stigation strategies an	d techniques. Model
	projects can be devised and treated.			
Personal Competence				
Social Competence	Students can discuss technical and scie	entific tasks within a seminar subject specific and	d interdisciplinary .	
Autonomy	Students can independently exploit sou	irces , acquire the particular knowledge of the su	ubject and apply it to ne	ew problems.
Workload in Hours	Independent Study Time 96, Study Tim	e in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	2 Std. 15 Min.			
scale				
Assignment for the	Civil Engineering: Specialisation Water	and Traffic: Elective Compulsory		
Following Curricula	Water and Environmental Engineering:	Core Qualification: Compulsory		
		· ·		

Course L1428: Biology	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Anna Krüger, Prof. Garabed Antranikian
Language	DE/EN
Cycle	WiSe
Content	
Literature	Umweltmikrobiologie, Reineke, W. und Schlömann, M. (2015) 2. Aufl., Springer Spektrum Verlag

Course L0903: Geology and S	Soil Science
Тур	Lecture
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dr. Joachim Gerth, Sonja Götz
Language	DE
Cycle	WiSe
Content	Geology: formation of the Earth, plate tectonics, macroscopic rock identification, introduction to Earth history, introduction to halokinesis. Soil science: soil use and function in ecosystems, faktors and processes of soil formation, mineral and organic components, surface types and properties, retention of nutrients and pollutants, hazards from faulty land use, erosion, salinization, and contamination, measures to preserve soils
Literature	R. Vinx (2011): "Gesteinsbestimmung im Gelände" H. Bahlburg & C. Breitkreutz (2012): "Grundlagen der Geologie", TUB Signatur GWB-318 R. Walter (2003): "Ergeschichte" TUB Signatur: 2816-1769 F.Scheffer und P. Schachtschabel (2002): "Lehrbuch der Bodenkunde" TUB Signatur AGG-308 W.E.H. Blum (2007): "Bodenkunde in Stichworten" TUB Signatur AGG-317

Course L0354: Environmenta	I Analysis
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Dorotnea Rechtenbach, Dr. Henning Mangels
Cvcle	WiSe
Content	Introduction
	Sampling in different environmental compartments, sample transportation, sample storage
	Sample preparation
	Photometry
	Wastewater analysis
	Introduction into chromatography
	Gas chromatography
	HPLC
	Mass spectrometry
	Optical emission spectrometry
	Atom absorption spectrometry
	Quality assurance in environmental analysis
Literature	Roger Reeve, Introduction to Environmental Analysis, John Wiley & Sons Ltd., 2002 (TUB: USD-728)
	Pradyot Patnaik, Handbook of environmental analysis: chemical pollutants in air, water, soil, and solid wastes, CRC Press, Boca Raton, 2010 (TUB: USD-716)
	Chunlong Zhang, Fundamentals of Environmental Sampling and Analysis, John Wiley & Sons Ltd., Hoboken, New Jersey, 2007 (TUB: USD-741)
	Miroslav Radojević, Vladimir N. Bashkin, Practical Environmental Analysis RSC Publ., Cambridge, 2006 (TUB: USD-720)
	Werner Funk, Vera Dammann, Gerhild Donnevert, Sarah Iannelli (Translator), Eric Iannelli (Translator), Quality Assurance in Analytical Chemistry: Applications in Environmental, Food and Materials Analysis, Biotechnology, and Medical Engineering, 2nd Edition, WILEY-VCH Verlag GmbH & Co. KGaA,Weinheim, 2007 (TUB: CHF-350)
	STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER, 21st Edition, Andrew D. Eaton, Leonore S. Clesceri, Eugene W. Rice, and Arnold E. Greenberg, editors, 2005 (TUB:CHF-428)
	K. Robards, P. R. Haddad, P. E. Jackson, Principles and Practice of Modern Chromatographic Methods, Academic Press
	G. Schwedt, Chromatographische Trennmethoden, Thieme Verlag
	H. M. McNair, J. M. Miller, Basic Gas Chromatography, Wiley
	W. Gottwald, GC für Anwender, VCH
	B. A. Bidlingmeyer, Practical HPLC Methodology and Applications, Wiley
	K. K. Unger, Handbuch der HPLC, GIT Verlag
	G. Aced, H. J. Möckel, Liquidchromatographie, VCH
	Charles B. Boss and Kenneth J. Fredeen, Concepts, Instrumentation and Techniques in Inductively Coupled Plasma Optical Emission Spectrometry Perkin-Elmer Corporation 1997, On-line available at: http://files.instrument.com.cn/bbs/upfile/2006291448.pdf
	Atomic absorption spectrometry: theory, design and applications, ed. by S. J. Haswell 1991 (TUB: 2727-5614)
	Royal Society of Chemistry, Atomic absorption spectometry (http://www.kau.edu.sa/Files/130002/Files/6785_AAs.pdf)

Module M1403: Const	ruction and Sin	nulation of S	ewerage Syste	ms			
Courses							
Title				Тур	Hrs/w	/k	СР
Construction and renovation of urb	an sewer systems (L1998	3)		Seminar	3		3
Simulation of sewerage systems (L	.2006)			Seminar	3		3
Module Responsible	Prof. Ralf Otterpohl						
Admission Requirements	None						
Recommended Previous Knowledge	 Hydraulics in pi Mechanics Soil mechanics Knowledge abo 	pes and gravity-se and foundation er ut urban sewerage	ewers Igineering 9 systems and water m	anagement			
Educational Objectives	After taking part succe	essfully, students l	have reached the follow	ving learning results			
Professional Competence							
Knowledge Skills	Students can describe urban wastewater systems by means of software-based modeling. In case studies they can perform system and weak point analyzes. In addition, they can analyze the hydraulic effects quantitatively. Furthermore, they have the knowledge to comprehend flow events in gravity-sewers based on the St. Venant equations. Students have knowledge of static and structural requirements of the sewer system. Cases of damage are investigated and the knowledge regarding different renovation technologies for sewer systems is acquired.						
	Moreover, they can de	etermine suitable o	construction materials a	and static requirement	nts for different cases	s of applic	ation.
Personal Competence							
Social Competence	Students are able to a	pply the acquired	skills in a team and ca	n impart this knowled	lge.		
Autonomy	Students can solve p simulation of sewer sy	problems in the f stems. Furthermo	ield of wastewater sy re, they are able to pre	stems independentl sent and justify their	y, concerning in pa solutions.	rticular d	dimensioning and
Workload in Hours	Independent Study Tir	me 96, Study Time	in Lecture 84				
Credit points	6						
Course achievement	CompulsoryBonusNo20 %	Form Presentation	Description				
Examination	Written elaboration						
Examination duration and scale	nach Absprache						
Assignment for the	Civil Engineering: Spe	cialisation Water a	nd Traffic: Compulsory				
Following Curricula	Water and Environme	ntal Engineering: S	Specialisation Water: C	ompulsory			
	Water and Environme	ntal Engineering: S	Specialisation Environm	ent: Elective Compu	lsory		

Course L1998: Construction	and renovation of urban sewer systems	
Тур	Seminar	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Ingo Weidlich	
Language	EN	
Cycle	WiSe	
Content	The lecture focusses on construction and renovation of urban se	wer pipelines.
	Construction:	
	 Pipe materials, types and joint technology 	
	Open trenches	
	Trenchless technologies	
	Pipe Statics:	
	Design of sewers according to ATV A 127 Earth pressure on pipes, pipe deformation, cutting forces.	
	Comparison with other international calculation approach	es
	Renovation:	
	Failure case study	
	Overview on the different renovation technologies	
	Liner design according to DWA-A 143	
Literature	Nr.	Titel
	1	ATV A 127, Abwassertechnische Vereinigung e.V., Arbeitsblatt A
		127, Regelwerk Abwasser-Abfall, Vertrieb: GFA, DK 628.22
	2	(183),A 127, 2000 DIN FN 1610. Verleauna und Präfung von Abwasserleitungen und
	_	-kanälen, Beuth Verlag, Berlin, 1997
	3	Arbeitsblatt DWA-A 143-1, Sanierung von
		Entwässerungssystemen außerhalb von Gebäuden, Teil 1:
		Planung und Überwachung von Sanierungsmaßnahmen Februar
	4	2015 Arbeitshlatt DWA-A 143-2. Sanierung von
	7	Entwässerungssystemen außerhalb von Gebäuden Teil 2:
		Statische Berechnung zur Sanierung von Abwasserleitungen und
		-kanälen mit Lining und Montageverfahren, Juli 2015
	5	DIN EN 752:2008, 2008: Entwässerungssysteme außerhalb von
	<u>م</u>	Gebäuden - Kanalmanagement.
		Rohrleitungssysteme
	7	Handbuch für den Rohrleitungsbau Band 1 und 2, 4. Auflage,
		Günter Wossog, 2015
	8	Rohrleitungstechnik, Walter Wagner, Vogel Buchverlag, 2006
	9	Stein D., Stein R., "Instandnaitung von Kanalisationen, 1000 S., ISBN 978-3-9810648-4-1 I Verlag Prof Dr-Ing Stein & Partner
		GmbH. 2014
	10	Stein, D., "Grabenloser Leitungsbau", 1. Auflage, Gebundene
		Ausgabe - 1166 Seiten, Ernst & Sohn Verlag, 2003, ISBN:
		3433017786
	11	Willoughby D:A: "Horizontal Directional Drilling: Utility and
		Pipeline Applications" Digital Engineering Library @ McGraw-Hill - The McGraw-Hill Companies Inc. 2005
	12	Weidlich I Erddruck auf Bohre" 1 Auflage ISBN 3-89999-027-
		7 227 Seiten 2012

Course L2006: Simulation of sewerage systems		
Тур	Seminar	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Ralf Otterpohl	
Language	EN	
Cycle	WiSe	
Content	Modeling of sewer systems:	
	 Modeling approaches in wastewater management, especially approaches to integrated modeling Planning processes, calculations and design approaches for elements of gravity-sewers Model setup St. Venant equation and simplifications of models (kinematic wave etc.) Calculation & modeling of solids transport (advection, diffusion, dispersion and sales processes) Examples for modeling with SWMM (EPA, USA) 	
Literature		

Module M0874: Wast	ewater Systems			
Courses				
Title		Түр	Hrs/wk	СР
Wastewater Systems - Collection, 1	reatment and Reuse (L0934)	Lecture	2	2
Wastewater Systems - Collection, 1	reatment and Reuse (L0943)	Recitation Section (large) 1	1
Advanced Wastewater Treatment (L0357)	Lecture	2	2
Advanced Wastewater Treatment (L0358)	Recitation Section (large) 1	1
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous	Knowledge of wastewater management an	d the key processes involved in wastewater t	eatment.	
Knowledge				
Educational Objectives	After taking part successfully, students have	ve reached the following learning results		
Professional Competence				
Knowledge	Students are able to outline key areas of the	he full range of treatment systems in waste v	vater management,	as well as their mutua
	dependence for sustainable water protection	on. They can describe relevant economic, env	ironmental and soci	al factors.
SKIIIS	Students are able to pre-design and expla	an the available wastewater treatment proce	esses and the scope	e of their application in
	municipal and for some industrial treatmen	it plants.		
Personal Competence				
Social Competence	Social skills are not targeted in this module	<u>.</u>		
Autonomy	y Students are in a position to work on a subject and to organize their work flow independently. They can also present on this			
	subject.			
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
Credit points	6			
Course achievement	None	None		
Examination	Written exam			
Examination duration and	120 min	120 min		
scale				
Assignment for the	Civil Engineering: Specialisation Structural	Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnic	cal Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal En	gineering: Elective Compulsory		
	Civil Engineering: Specialisation Water and	Traffic: Compulsory		
	Bioprocess Engineering: Specialisation A - 0	General Bioprocess Engineering: Elective Com	ipulsory	
	Energy and Environmental Engineering: Sp	ecialisation Environmental Engineering: Elect	ive Compulsory	
	Environmental Engineering: Specialisation	Water: Elective Compulsory		
	International Management and Engineering: Specialisation II. Energy and Environmental Engineering: Elective Compu			e Compulsory
	International Management and Engineering: Specialisation II. Process Engineering and Biotechnology: Elective Compulsor			ve Compulsory
	Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory			
	Process Engineering: Specialisation Process	s Engineering: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Water: Compulsory			
	Water and Environmental Engineering: Spe	cialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Spe	cialisation Cities: Compulsory		

Course L0934: Wastewater S	ystems - Collection, Treatment and Reuse
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	SoSe
Content	•Understanding the global situation with water and wastewater
	•Regional planning and decentralised systems
	•Overview on innovative approaches
	•In depth knowledge on advanced wastewater treatment options for different situations, for end-of-pipe and reuse
	•Mathematical Modelling of Nitrogen Removal
	•Exercises with calculations and design
Literature	Henze, Mogens:
	Wastewater Treatment: Biological and Chemical Processes, Springer 2002, 430 pages
	George Tchobanoglous Franklin I. Burton, H. David Stensel
	Wastewater Engineering: Treatment and Reuse. Metcalf & Eddy
	McGraw-Hill, 2004 - 1819 pages

Course L0943: Wastewater Systems - Collection, Treatment and Reuse	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0357: Advanced Wastewater Treatment	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Joachim Behrendt
Language	EN
Cycle	SoSe
Content	Survey on advanced wastewater treatment
	reuse of reclaimed municipal wastewater
	Precipitation
	Flocculation
	Depth filtration
	Membrane Processes
	Activated carbon adsorption
	Ozonation
	"Advanced Oxidation Processes"
	Disinfection
Literature	Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003
	Wassertechnologie, H.H. Hahn, Springer-Verlag, Berlin 1987
	Membranverfahren: Grundlagen der Modul- und Anlagenauslegung, T. Melin und R. Rautenbach, Springer-Verlag, Berlin 2007
	Trinkwasserdesinfektion: Grundlagen, Verfahren, Anlagen, Geräte, Mikrobiologie, Chlorung, Ozonung, UV-Bestrahlung, Membranfiltration, Qualitätssicherung, W. Roeske, Oldenbourg-Verlag, München 2006
	Organische Problemstoffe in Abwässern, H. Gulyas, GFEU, Hamburg 2003
Course L0358: Advanced Wa	stewater Treatment
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Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Joachim Behrendt
Language	EN
Cycle	SoSe
Content	Aggregate organic compounds (sum parameters)
	Industrial wastewater
	Processes for industrial wastewater treatment
	Precipitation
	Flocculation
	Activated carbon adsorption
	Recalcitrant organic compounds
Literature	Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003
	Wassertechnologie, H.H. Hahn, Springer-Verlag, Berlin 1987
	Membranverfahren: Grundlagen der Modul- und Anlagenauslegung, T. Melin und R. Rautenbach, Springer-Verlag, Berlin 2007
	Trinkwasserdesinfektion: Grundlagen, Verfahren, Anlagen, Geräte, Mikrobiologie, Chlorung, Ozonung, UV-Bestrahlung,
	Membranfiltration, Qualitätssicherung, W. Roeske, Oldenbourg-Verlag, München 2006
	Organische Problemstoffe in Abwässern, H. Gulyas, GFEU, Hamburg 2003

Module M0828: Urbar	n Environmental Management			
Courses				
Title	Тур		Hrs/wk	СР
Noise Protection (L1109)	Lecture		2	2
Urban Infrastructures (L0874)	Project-/prol	blem-based Learning	2	4
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
Recommended Previous	Knowledge on Urban planning			
Knowledge	Knowledge on measures for climate protection			
	General knowledge of scientific writing/working			
Educational Objectives	After taking part successfully, students have reached the following learning u	results		
Professional Competence	Fire taking pare successiony, students have reactice the following rearning i	Cours		
Knowledae	Students can describe urban development corridors as well as current and f	uture urban environn	nental proble	ms. They are able to
	explain the causes of environmental problems (like noise).			
	Students can specify applications for various technical innovations and expl	ain why these contrib	bute to the im	provement of urban
	life. They can, for example, derive and discuss measures for effective noise a	abatement.		
Chille	Students are able to develop specific solutions for correcting evicting	or futuro onviron	mont related	problems of urban
SKIIIS	students are able to develop specific solutions for correcting existing	for onvironmental p	ment-related	forest development
	naths. To solve specific urban environmental problems they can select tec	hnical innovations a	nd integrate t	hem into the urban
	context.		na integrate t	
Personal Competence				
Social Competence	The students can work together in international groups.			
Autonomi	Students are able to arganize their work flow to prepare themselves for pro-	contations and cont	ributions to th	a discussions They
Autonomy	students are able to organize their work now to prepare themselves for pre	esentations and cont		le discussions. They
	can acquire appropriate knowledge by making enquiries independently.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Written Report plus oral Presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compuls	ory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory			
	Environmental Engineering: Core Qualification: Elective Compulsory			
	Loint European Master in Environmental Studies - Cities and Sustainability	ore Qualifications Car	nnulson	
	Joint European master in Environmental studies - Cities and Sustainability: O	ty: Elective Computer	orv	
	Water and Environmental Engineering: Specialisation Environment: Elective		Ul y	
	Water and Environmental Engineering: Specialisation Cities: Compulsory	compulsory		
	mater and Environmental Engineering. Specialisation ences, compulsory			

Course L1109: Noise Protection		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Martin Jäschke	
Language	EN	
Cycle	SoSe	
Content		
Literature	1) Müller & Möser (2013): Handbook of Engineering Acoustics (also available in German)	
	2) WHO (1999): Guidelines for Community Noise	
	3) Environmental Noise Directive 2002/49/EG	
	4) ISO 9613-2 (1996): Acoustics, Attenuation of sound during propagation outdoors, Part 2: General method of calculation	

Course L0874: Urban Infrastructures	
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Dr. Dorothea Rechtenbach
Language	EN
Cycle	SoSe
Content	Problem Based Learning
	 Main topics are: Central vs. Decentral Wastewater Treatment. Compaction of Cities. Car Free Cities. Multifunctional Places in Cities. The Sustainability of Freight Transport in Cities.
Literature	Depends on chosen topic.

Module M0703: Soil a	nd Groundwater Contamination	on		
Courses				
Title		Тур	Hrs/wk	СР
Contamination and Remediation (L	0547)	Project Seminar	3	3
NAPL in Soil and Groundwater (L05	45)	Lecture	1	1
NAPL in Soil and Groundwater (L05	46)	Recitation Section (small)	2	2
Module Responsible	NN			
Admission Requirements	None			
Recommended Previous Knowledge	Ground water hydrologyGeohydraulic and solute transportHydromechanics			
Educational Objectives	After taking part successfully, students hav	e reached the following learning results		
Professional Competence				
Knowledge	The students are able to analyse contamination in soils and groundwater. They are able to create remediation concepts for LNAPL contamnations. They are faminliar with Monitored Natural Attenuation			
Skills	The students are able to analyse contaminations in soils and groundwater using special engineering methods. They can do transport modelling in the unsaturated zone, estimations of groundwater pollution and analyse the impacts of remediation measures. They can forecast die distribution, mobility and remediation of non aquaous phase liquids in soil and groundwater			
Personal Competence				
Social Competence	The students are able to prepare complex contamination issues in teamwork and are able to find remediation measures.			
Autonomy	None			
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	Klausur 60 min: Referat 15 min:			
scale				
Assignment for the	Civil Engineering: Specialisation Water and	Traffic: Elective Compulsory		
Following Curricula	Water and Environmental Engineering: Spe	cialisation Water: Elective Compulsory		
-	Water and Environmental Engineering: Spe	cialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Spe	cialisation Cities: Elective Compulsory		

Course L0547: Contamination and Remediation	
Тур	Project Seminar
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Nima Shokri, Hannes Nevermann
Language	EN
Cycle	SoSe
Content	Processing of a complex soil and groundwater contamination site. Students perform analyses of data to detect the contamination
	and to analyse the groundwater hazard and to develop a concept for remediation of the damage.
Literature	entfällt

Course L0545: NAPL in Soil and Groundwater		
Тур	Lecture	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Nima Shokri	
Language	EN	
Cycle	SoSe	
Content	concept of capillarity, multi phase distribution in poraus media, residual saturation, rellative permeability, infiltration of NAPL into	
	the subsurface, vertical distribution of LNAPL, specific volume	
Literature	Charbeneau, R.J. (2000): Groundwater Hydraulics and pollutant Transport	

Course L0546: NAPL in Soil and Groundwater	
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Nima Shokri
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1351: Const	ruction Processes			
Courses				
Title		Тур	Hrs/wk	СР
Digital Building (L1908)		Lecture	2	2
Lean Construction (L1910)		Lecture	2	2
System Dynamics (L1909)		Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal I	Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotech	nical Engineering: Elective Compulsory		
-	Civil Engineering: Specialisation Structura	al Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water ar	nd Traffic: Elective Compulsory		

Course L1908: Digital Building	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Katja Maaser
Language	DE
Cycle	SoSe
Content	
Literature	

Course L1910: Lean Construction	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Theo Herzog
Language	DE
Cycle	SoSe
Content	
Literature	

Course L1909: System Dynamics	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Markus Salge
Language	DE
Cycle	SoSe
Content	
Literature	

Typ Hrs/wk CP pplied Surface Hydrology (L0289) Lecture 2 2 pplied Surface Hydrology (L1412) Project-/problem-based Learning 1 2 iteraction Water - Environment in Fluvial Areas (L0295) Project-/problem-based Learning 1 2 Module Responsible Prof. Peter Fröhle Vanage Vanage
Scourses Typ Hrs/wk CP spplied Surface Hydrology (L0289) Lecture 2 2 spplied Surface Hydrology (L1412) Project-/problem-based Learning 1 2 steraction Water - Environment in Fluvial Areas (L0295) Project-/problem-based Learning 1 2 Module Responsible Prof. Peter Fröhle Version Version Version
Typ Hrs/wk CP ypplied Surface Hydrology (L0289) Lecture 2 2 ypplied Surface Hydrology (L1412) Project-/problem-based Learning 1 2 tteraction Water - Environment in Fluvial Areas (L0295) Project-/problem-based Learning 1 2 Module Responsible Prof. Peter Fröhle V V V
Applied Surface Hydrology (L0289) Lecture 2 2 Applied Surface Hydrology (L1412) Project-/problem-based Learning 1 2 Interaction Water - Environment in Fluvial Areas (L0295) Project-/problem-based Learning 1 2 Module Responsible Prof. Peter Fröhle V V V
Applied Surface Hydrology (L1412) Project-/problem-based Learning 1 2 Interaction Water - Environment in Fluvial Areas (L0295) Project-/problem-based Learning 1 2 Module Responsible Prof. Peter Fröhle 2
Interaction Water - Environment in Fluvial Areas (L0295) Project-/problem-based Learning 1 2 Module Responsible Prof. Peter Fröhle
Module Responsible Prof. Peter Fröhle
Admission Dequirements None
Aumssion Requirements None
Recommended Previous Fundamentals of Hydromechanics and Hydraulic Engineering: Hydraulic Engineering I and Hydraulic Engineering II
Knowledge
Educational Objectives After taking part successfully, students have reached the following learning results
Professional Competence
Knowledge The students are able to define the basic concepts of hydrology and water management. They are able to describe and quant
the relevant processes of the hydrological water cycle. Besides, the students know the main aspects of rainfall-run-off-models a
are able to theoretically derive established reservoir / storage models and a unit-hydrograph.
Skills The students are able to use the basic hydrological concepts and approaches and are able to theoretically derive establish
reservoir / storage models or a unit-hydrograph as the basis for rainfall-run-off-models. The student are able to explain the ba
concepts of measurements of hydrological and hydrodynamic values in nature and are able to perform, analyze and statistica
assess these measurements. Furthermore, they are able to apply a hydrological model to basic hydrological problems.
Personal Competence
Social Competence The students are able to deploy their gained knowledge in applied problems of the hydrology and water management. Additiona
they will be able to work in team with engineers of other disciplines.
Autonomy The students will be able to independently extend their knowledge and apply it to new problems
Workload in Hours Independent Study Time 124, Study Time in Lecture 56
Credit points 6
Course achievement None
Examination Written exam
Examination duration and The duration of the examination is 90 min. The examination includes tasks with respect to the general understanding of the lecture
scale contents and calculations tasks.
Assignment for the Civil Engineering: Specialisation Water and Traffic: Elective Compulsory
Following Curricula Environmental Engineering: Core Qualification: Elective Compulsory
Joint European Master in Environmental Studies - Cities and Sustainability: Core Qualification: Compulsory
Water and Environmental Engineering: Specialisation Water: Elective Compulsory
Water and Environmental Engineering: Specialisation Environment: Elective Compulsory
Water and Environmental Engineering: Specialisation Cities: Elective Compulsory

Course L0289: Applied Surfa	ce Hydrology
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Peter Fröhle
Language	DE/EN
Cycle	SoSe
Content	Basics of hydrology:
	 Hydrological cycle Data acquisition Data analyses and statistical assessment Statistics of extremes Regionalization methods for hydrological values Rainfall-run-off modelling on the basis of a unit hydrograph conceps Application of rainfall-run-off models on the basis of Kalypso-Hydrology which is an OpenSource Software Tool.
Literature	http://de.wikipedia.org/wiki/Kalypso_(Software)
	http://kalypso.bjoernsen.de/
	http://sourceforge.net/projects/kalypso/
L	

Course L1412: Applied Surface Hydrology	
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0295: Interaction W	ater - Environment in Fluvial Areas
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE/EN
Cycle	SoSe
Content	A problem based learning course. The problem will be solved by the students more or less self-contained. The topics will be
	introduced and elaborated over the semester.
Literature	-

Module M0875: Nexu	s Engineering - Water, Soil, Food and	d Energy		
Courses				
Title Ecological Town Design - Water, Er	nergy, Soil and Food Nexus (L1229)	Typ Seminar	Hrs/wk	CP 2
water & wastewater Systems in a		Lecture	Z	4
Module Responsible				
Recommended Previous Knowledge	Basic knowledge of the global situation with rising sanitation	poverty, soil degradation, migr	ation to cities, lack of v	vater resources and
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	Students can describe the facets of the global water s synergistic systems in Water, Soil, Food and Energy s	situation. Students can judge the supply.	enormous potential of th	ne implementation of
Skills	Students are able to design ecological settlements f around the world.	or different geographic and soci	o-economic conditions fo	or the main climates
Personal Competence				
Social Competence	The students are able to develop a specific topic in a	team and to work out milestones	according to a given pla	in.
Autonomy	Students are in a position to work on a subject an subject.	d to organize their work flow in	dependently. They can a	also present on this
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	During the course of the semester, the students wor	k towards mile stones. The work	includes presentations	and papers. Detailed
scale	information can be found at the beginning of the sme	ester in the StudIP course module	handbook.	
Assignment for the	Civil Engineering: Specialisation Water and Traffic: Ele	ective Compulsory		
Following Curricula	Bioprocess Engineering: Specialisation A - General Bio	oprocess Engineering: Elective Co	ompulsory	
	Chemical and Bioprocess Engineering: Specialisation	General Process Engineering: Ele	ective Compulsory	
	Environmental Engineering: Core Qualification: Election	ve Compulsory		
	Joint European Master in Environmental Studies - Citie	es and Sustainability: Core Qualif	ication: Compulsory	
	Process Engineering: Specialisation Environmental Process Engineering: Specialisation Environmen	ocess Engineering: Elective Com	pulsory	
	Process Engineering: Specialisation Process Engineer	ing: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Water: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Environment: Elective Compulso	ory	
	Water and Environmental Engineering: Specialisation	Cities: Elective Compulsory		

Course L1229: Ecological Tov	wn Design - Water, Energy, Soil and Food Nexus
Тур	Seminar
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	SoSe
Content	 Participants Workshop: Design of the most attractive productive Town Keynote lecture and video The limits of Urbanization / Green Cities The tragedy of the Rural: Soil degradation, agro chemical toxification, migration to cities Global Ecovillage Network: Upsides and Downsides around the World Visit of an Ecovillage Participants Workshop: Resources for thriving rural areas, Short presentations by participants, video competion TUHH Rural Development Toolbox Integrated New Town Development Participants workshop: Design of New Towns: Northern, Arid and Tropical cases Outreach: Participants campaign City with the Rural: Resilience, quality of live and productive biodiversity
Literature	 Ralf Otterpohl 2013: Gründer-Gruppen als Lebensentwurf: "Synergistische Wertschöpfung in erweiterten Kleinstadt- und Dorfstrukturen", in "Regionales Zukunftsmanagement Band 7: Existenzgründung unter regionalökonomischer Perspektive, Pabst Publisher, Lengerich http://youtu.be/9hmkgn0nBgk (Miracle Water Village, India, Integrated Rainwater Harvesting, Water Efficiency, Reforestation and Sanitation) TEDx New Town Ralf Otterpohl: http://youtu.be/_M0J2u9BrbU

Course L0939: Water & Wast	ewater Systems in a Global Context
Тур	Lecture
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	SoSe
Content	 Keynote lecture and video Water & Soil: Water availability as a consequence of healthy soils Water and it's utilization, Integrated Urban Water Management Water & Energy, lecture and panel discussion pro and con for a specific big dam project
	 Rainwater Harvesting on Catchment level, Holistic Planned Grazing, Multi-Use-Reforestation Sanitation and Reuse of water, nutrients and soil conditioners, Conventional and Innovative Approaches Why are there excreta in water? Public Health, Awareness Campaigns Rehearsal session, Q&A
Literature	 Montgomery, David R. 2007: Dirt: The Erosion of Civilizations, University of California Press Liu, John D.: http://eempc.org/hope-in-a-changing_climate/ (Integrated regeneration of the Loess Plateau, China, and sites in Ethiopia and Rwanda) http://youtu.be/9hmkgn0nBgk (Miracle Water Village, India, Integrated Rainwater Harvesting, Water Efficiency, Reforestation and Sanitation)

Module M0922: City F	Planning		
Courses			
Title	Түр	Hrs/wk	СР
City Planning (L1066)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Carsten Gertz		
Admission Requirements	None		
Recommended Previous	for "Principles of Urban Planning": none		
Knowledge	for "Decigning Linhan Streatscapes", come knowledge of transport planning, e.g. through taking t	houndorgrad	uato class. Transport
	Planning and Traffic Engineering"	ne undergrad	
	······································		
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	Students are able to:		
	use technical terms of urban planning.		
	describe the main determinants of urban development.		
	explain and compare different possibilities of how urban development can be influenced.		
	 discuss requirements for public streetscapes. 		
	explain the importance of street design.		
Ckille	Students are able to		
SKIIIS	Students are able to:		
	 read and analyze urban development concepts and designs for streetscapes 		
	 appraise such concepts in the context of competing requirements. 		
	 design, justify and reflect their own solutions for concrete examples. 		
Personal Competence			
Social Competence	Students are able to:		
	discuss intermediate results with each other.		
	constructively accept feedback on their own work.		
	provide constructive feedback to others.		
Autonomy	Students are able to:		
	 independently complete a written report including drawings following a broadly pre-define 	d process.	
	 assess the consequences of their proposed solutions. 		
	independently acquire knowledge and apply this to new issues or problem areas.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Credit points	6		
Course achievement	None		
Examination	Written elaboration		
Examination duration and	written assignment, designwork during the semester		
scale			
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory		
	Livii Engineering: Specialisation Water and Traffic: Elective Compulsory	0.57	
	Logistics, initiastructure and mobility: Specialisation intrastructure and Mobility: Elective Compuls	ory	
	Water and Environmental Engineering: Specialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Cities: Compulsory		

Course L1066: City Planning	
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Carsten Gertz
Language	DE
Cycle	SoSe
Content	"Principles of Urban Planning" deals with the determinants of urban development and their interactions. Topics include:
	 legal framework, instruments and methods of planning, functional requirements, stakeholders and actors basic design requirements different planning levels and historical contexts. The objective of the course is for students to acquire a basic understanding of urban development problems and approaches for solving them. They will also be able to comprehend the process of urban planning. The course also covers the various functional and aesthetic requirements for designing streetscape as the most important elements of public space. The project work deals with a real life scenario and includes drawing up a development plan, an urban design concept, a building masterplan and a street redesign.
Literature	Albers, Gerd; Wekel, Julian (2009) Stadtplanung: Eine illustrierte Einführung. Primus Verlag. Darmstadt. Frick, Dieter (2008) Theorie des Städtebaus: Zur baulich-räumlichen Organisation von Stadt. Wasmuth-Verlag. Tübingen Jonas, Carsten (2009) Die Stadt und ihr Grundriss. Wasmuth-Verlag. Tübingen Kostof, Spiro; Castillo, Greg (1998) Die Anatomie der Stadt. Geschichte städtischer Strukturen. Campus-Verlag. Frankfurt/New York.

Module M0977: Const	ruction Logistics and Project Manage	ement		
Courses				
Title		Тур	Hrs/wk	СР
Construction Logistics (L1163)		Lecture	1	2
Construction Logistics (L1164)		Recitation Section (small)	1	2
Project Development and Managen	nent (L1161)	Lecture	1	1
Project Development and Managen	nent (L1162)	Project-/problem-based Learning	1	1
Module Responsible	Prof. Heike Flämig			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	Students can			
	 give definitions of the main terms of construction 	on logistics and project development and n	nanagement	
	 name advantages and disadvantages of international structure in the structure internation structure in the structure internation structure in the structure internation structure internation structure internation structure in the structure internation structure internat	al or external construction logistics		
	 explain characteristics of products, demand an 	d production of construction objects and th	neir conseque	ences for construction
	specific supply chains			
	differentiate constructions logistics from other	logistics systems		
CI-ill-	Chudanha ann			
SKIIIS	Students can			
	 carry out project life cycle assessments 			
	 apply methods and instruments of construction 	logistics		
	 apply methods and instruments of project development 	lopment and management		
	 apply methods and instruments of conflict man 	agement		
	 design supply and waste removal concepts for 	a construction project		
Personal Competence				
Social Competence	Students can			
Social competence				
	 hold presentations in and for groups 			
	 apply methods of conflict solving skills in group 	work and case studies		
Autonomy	Students can			
	 solve problems by holistic, systemic and flow o 	riented thinking		
	 improve their creativity, negotiation skills, co 	nflict and crises solution skills by applyin	g methods o	f moderation in case
	studies			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Two written papers with presentations			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineerin	g: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineer	ering: Elective Compulsory		
_	Civil Engineering: Specialisation Coastal Engineering:	Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Ele	ective Compulsory		
	International Management and Engineering: Specialis	ation II. Civil Engineering: Elective Compuls	sory	
	International Management and Engineering: Specialis	ation II. Logistics: Elective Compulsorv	-	
	Logistics, Infrastructure and Mobility: Specialisation P	roduction and Logistics: Elective Compulso	ry	
	Logistics. Infrastructure and Mobility: Specialisation In	frastructure and Mobility: Elective Compute	sorv	
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Course L1163: Construction	Logistics
Тур	Lecture
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Heike Flämig
Language	DE
Cycle	SoSe
Content	The lecture gives deeper insight how important logistics are as a competetive factor for construction projects and which issues are to be adressed. The following toppics are covered:
	 competetive factor logistics the concept of systems, planning and coordination of logistics material, equipment and reverse logistics IT in construction logistics elements of the planning model of construction logistics and their connections flow oriented logistics systems for construction projects logistics concepts for ready to use construction projects (especially procurement and waste removel logistics) best practice examples (construction logistics Potsdamer Platz, recent case study of the region)
Literature	 Flämig, Heike: Produktionslogistik in Stadtregionen. In: Forschungsverbund Ökologische Mobilität (Hrsg.) Forschungsbericht Bd. 15.2. Wuppertal 2000. Krauss, Siri: Die Baulogistik in der schlüsselfertigen Ausführung, Bauwerk Verlag GmbH Berlin 2005. Lipsmeier, Klaus: Abfallkennzahlen für Neubauleistungen im Hochbau : Verlag Forum für Abfallwirtschaft und Altlasten, 2004. Schmidt, Norbert: Wettbewerbsfaktor Baulogistik. Neue Wertschöpfungspotenziale in der Baustoffversorgung. In: Klaus, Peter: Edition Logistik. Band 6. Deutscher Verkehrs-Verlag. Hamburg 2003. Seemann, Y.F. (2007): Logistikkoordination als Organisationseinheit bei der Bauausführung Wissenschaftsverlag Mainz in Aachen, Aachen. (Mitteilungen aus dem Fachgebiet Baubetrieb und Bauwirtschaft (Hrsg. Kuhne, V.): Heft 20)

Course L1164: Construction Logistics	
Тур	Recitation Section (small)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Heike Flämig
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1161: Project Development and Management	
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Heike Flämig, Dr. Anton Worobei
Language	DE
Cycle	SoSe
Content	Within the lecture, the main aspects of project development and management are tought:
	 Terms and definitions of project management Advantages and disadvantages of different ways of project handling organization, information, coordination and documentation cost and fincance management in projects time- and capacity management in projects specific methods and instruments for successful team work Contents of the lecture are deepened in special exercises.
Literature	Projektmanagement-Fachmann. Band 1 und Band 2. RKW-Verlag, Eschborn, 2004.

Course L1162: Project Development and Management	
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Heike Flämig, Dr. Anton Worobei
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0593: Building Materials and Building Preservation

Courses				
Title		Тур	Hrs/wk	СР
Repair of Structures (L0255)		Lecture	1	1
Mineral Building Materials (L0253)		Lecture	2	2
Technology of mineral Building Mat	erials (L0256)	Project-/problem-based Learning	1	2
Transport Processes in Building Ma	erials and Damage Processes (L0254)	Lecture	1	1
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous	Basic knowledge about building materials, building	physics and building chemistry, for exam	ple by the m	nodules Principles of
Knowledge	Building Materials and Building Physics and Building N	Materials and Building Chemistry.		
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students are able to describe the components of	mineral building materials and their functio	n in detail and	d to use them for the
	manufacture of special mineral building materials. Th	ey are able to show the characteristics of m	ineral building	g materials. They are
	able to describe the manufacture, properties and field	ds of application of special mortars and spec	cial concretes	and the correlations
	of their material parameters. They are able to show t	he principles of anchor technology and desig	jn.	
SKIIIS	The students are able to perform an optimization of g	granulometry of a mineral building material.	They are abl	e to design a special
	mineral mortar and to manufacture this mortar. The	students are able to manufacture post inst	alled rebar co	onnections. They are
	able to recognize damages, to assess possible cause	es, to use the fundamentals of construction	preservation	and to select repair
	and strengthening measures.			
Personal Competence				
Social Competence	The students are able to develop in small grous the	mixture of a special mortar. They present th	eir results to	the lecturer and the
	other students. In a critical discussion they defend	and adjust their results. The students are	able to manu	facture their special
	building material on the basis of this feedback.			
	T	and the second state of th		
Autonomy	The students are able to responsibly use the resource	es of materials and lab equipment for their	project and t	to investigate and to
	get missing components.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points	6			
Course achievement	Compulsory Bonus Form De	escription		
	Yes 20 % Subject theoretical and			
	practical work			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnical Engine	ering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engineering:	Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineering	ig: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Ele	ective Compulsory		

Course L0255: Repair of Structures	
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Frank Schmidt-Döhl
Language	DE
Cycle	SoSe
Content	Maintenance of structures, repair and strengthening, subsequent waterproofing of structures
Literature	BetonMarketing Deutschland (Hrsg.): Stahlbetonoberflächen - schützen, erhalten, instandsetzen

Course L0253: Mineral Building Materials	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Frank Schmidt-Döhl
Language	DE
Cycle	SoSe
Content	Components of mineral building materials and their function, binding materials, concrete and mortar, special mortars, special
	concretes
Literature	Taylor, H.F.W.: Cement Chemistry
	Springenschmid, R.: Betontechnologie für die Praxis

Course L0256: Technology of mineral Building Materials	
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Frank Schmidt-Döhl
Language	DE
Cycle	SoSe
Content	Design and production of a special mineral building material
Literature	Taylor, H.F.W.: Cement Chemistry
	Springenschmid, R.: Betontechnologie für die Praxis

Course L0254: Transport Processes in Building Materials and Damage Processes	
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Frank Schmidt-Döhl
Language	DE
Cycle	SoSe
Content	Transport Processes in Building Materials and Damage Processes
Literature	Blaich, J.: Bauschäden, Analyse und Vermeidung

Module M0998: Statio	s and Dynamics of Structures				
Courses					
Title		Тур		Hrs/wk	СР
Structural Dynamics (L1202)		Lecture	Soction (large)	2	2
Eracture mechanics and fatigue in	stool structures (L0564)	Recitation	Section (large)	2	2
Fracture mechanics and fatigue in		Becitation	Section (large)	1	1
Madula Deerersikle		Rectation	Section (large)	1	1
Admission Requirements	None				
Recommended Previous	Knowledge of linear structural analysis of stat	ically determinate and inc	leterminate structu	res: Mechanics	/II Mathematics I/I
Knowledge	Differential equations I	ically accertainate and inc		ines, meenames	
Kilowieuge					
Educational Objectives	After taking part successfully, students have read	ached the following learning	g results		
Professional Competence					
Knowledge	After successful completion of this module, the	e student can explain the	basic aspects of dy	namic effects or	n structures and the
	respective methods.				
Skills Personal Competence	After successful completion of this module, a dynamics loading using the appropriate comput	the students will be able ational approaches and me	to predict the resp ethods.	ponse of materia	al and structures to
Social Competence	Students can				
	 participate in subject-specific and interdi 	sciplinary discussions.			
	defend their own work results in front of	others			
	 promote the scientific development of co 	lleagues			
	 Furthermore, they can give and accept p 	- rofessional constructive cri	ticism		
Autonomy	Students are able to gain knowledge of the sub	ject area from given and o	ther sources and ap	oply it to new pro	blems. Furthermore
	they are able to structure the solution process f	or problems in the area of	Structural Analysis.		
Workload in Hours	Independent Study Time 96, Study Time in Lect	ure 84			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	150 min				
scale					
Acciment for the	Civil Engineering: Specialization Structured Frank	agoring Compulson			
Assignment for the	Civil Engineering: Specialisation Structural Engi	reering: Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical E	ngineering: Elective Compu	lisory		
	Civil Engineering: Specialisation Coastal Engine	ering: Elective Compulsory			
	Civil Engineering: Specialisation Water and Traf	ric: Elective Compulsory			
	International Management and Engineering: Sp	ecialisation II. Civil Enginee	ring: Elective Comp	uisory	

Course L1202: Structural Dy	namics
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	SoSe
Content	 Single-degree-of-freedom systems: undamped and damped vibration, free vibration, forced vibrations due to harmonic, periodical or arbitrary loading, natural frequency, damping vibration isolation solution in the frequency-domain (Fourier transformation), solution in the time-domain multi-degree-of-freedom systems: continuous or discrete systems, modelling with finite elements, generalisation modal analysis power iteration according to v.Mises earthquake loading: seismological basics, response spectrum method wind-induced vibrations: engineering meteorology, aerodynamic, classification of excitation mechanisms
Literature	Clough, R.W., Penzien, J.: Dynamics of Structures. 2. Aufl., McGraw-Hill, New York, 1993.

Course L1203: Structural Dynamics	
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0564: Fracture mech	hanics and fatigue in steel structures
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Jürgen Priebe
Language	DE
Cycle	SoSe
Content	 basics of fatigue stress and fatigue resistance and determination of fatigue strength,
	 determination and use of S-N-curves and classification of notch effects,
	• set up of determination of fatigue strength under dynamic load using the accumulation formula by Palmgren-Miner,
	 set up of determination of fatigue strength in different examples,
	 basics of construction and design regarding the problem of material fatigue,
	basics of linear elastic fracture mechanics under static and dynamic load,
	determination of lifetime of steel construction based on linear elastic fracture mechanics in different examples.
Literature	Seeßelberg, C.; Kranbahnen - Bemessung und konstruktive Gestaltung; 3. Auflage; Bauwerk-Verlag; Berlin 2009
	Kuhlmann, Dürr, Günther; Kranbahnen und Betriebsfestigkeit; in Stahlbau Kalender 2003; Verlag Ernst & Sohn; Berlin 2003
	Deutscher Stahlbau-Verband (Hrsg.); Stahlbau Handbuch Band 1 Teil B; 3. Auflage; Stahlbau-Verlagsgesellschaft; Köln 1996
	Petersen, C.; Stahlbau; 3. überarb. und erw. Auflage; Vieweg-Verlag; Braunschweig 1993
	 DIN V ENV 1993-1-1: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 1-1: Allgemeine Bemessungsregeln, Bemessungsregeln f ür den Hochbau; 1993
	DIN V ENV 1993-6: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 6: Kranbahnen; 2001
	DIN-Fachbericht 126. Richtlinie zur Anwendung von DIN V ENV 1993-6; Nationales Anwendungsdokument (NAD); Berlin 2002

Course L0565: Fracture mechanics and fatigue in steel structures	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Jürgen Priebe
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0982: Trans	sportation Modelling		
Courses			
Title	Тур	Hrs/wk	СР
Transportation Modelling (L1180)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Carsten Gertz		
Admission Requirements	None		
Recommended Previous	some knowledge of transport planning, e.g. through taking the undergraduate class "Transport	Planning and T	raffic Engineering"
Knowledge			
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	Students are able to understand the operation and potential applications of transport models.		
Skills	Students are able to:		
	 use travel demand modelling software packages for solving practical problems. design a database structure for travel demand models. assess modelling results. appraise potential applications and limitations of such models. 		
Personal Competence <i>Social Competence</i> <i>Autonomy</i>	 Students are able to independently develop and document solutions. Students are able to: independently organise, manage and solve set tasks. independently prepare written reports. 		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Credit points	6		
Course achievement	None		
Examination	Written elaboration		
Examination duration and	written assignment with presentation during the semester		
scale			
Assignment for the	Civil Engineering: Specialisation Water and Traffic: Compulsory		
Following Curricula	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective Compu	lsory	
	Water and Environmental Engineering: Specialisation Cities: Elective Compulsory		

Course L1180: Transportatio	n Modelling
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Carsten Gertz
Language	DE
Cycle	SoSe
Content	 Principles of transport modelling Role of transport modelling in the planning process Fundamentals of mobility behaviour Design and evaluation of transport/mobility surveys mode of operation and data requirements for different stages of modelling Forecasting and scenarios in the transport planning The range of model applications (from transport infrastructure planning over simulation of traffic flows to integrated land-use and transport models as well as the use of models for evaluating locations) Practice-oriented project for assessing consequences of infrastructure projects and changes in land-use
Literature	Lohse, Dieter und Schnabel, Werner (2011): Grundlagen der Straßenverkehrstechnik und der Verkehrsplanung – Band 2. 3. Auflage. Beuth. Ortúzar, Juan de Dios und Willumsen, Luis G. (2011): Modelling Transport. 4. Auflage. John Wiley & Sons.

Module M0749: Waste	e Treatment and Solid Matter F	Process Technology		
Courses				
Title		Тур	Hrs/wk	СР
Solid Matter Process Technology fo	r Biomass (L0052)	Lecture	2	2
Thermal Waste Treatment (L0320)		Lecture Resitation Section (I	2	2
Medule Responsible	Prof Korstin Kuchta	Recitation Section (i	arge) i	2
Admission Requirements	None			
Recommended Previous	Basics of			
Knowledge				
	thermo dynamics			
	 fluid dynamics chemistry 			
	chemistry			
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	The students can name, describe current engineering and contemplate them in the contemplate them in th	issue and problems in the field of th ntext of their field.	nermal waste treatment	and particle process
	The industrial application of unit operations	as part of process engineering is expla	ined by actual examples	of waste incineration
	technologies and solid biomass processes.	Compostion, particle sizes, transporta	tion and dosing, drying	and agglomeration of
	renewable resources and wastes are describ- and refining edible oils, electricity , heat and	ed as important unit operations when p mineral recyclables.	producing solid fuels and	bioethanol, producing
Skills	The students are able to select suitable proc	esses for the treatment of wastes or ra	w material with respect t	their characteristics
	and the process aims. They can evaluate the	efforts and costs for processes and sel	ect economically feasible	treatment concepts.
Personal Competence				
Social Competence	Students can			
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,				
	 respectfully work together as a team a 	nd discuss technical tasks		
	 participate in subject-specific and intel develop cooperated solutions 	alsciplinary discussions,		
	 promote the scientific development at 	nd accept professional constructive crit	icism.	
Autonomy	Students can independently tap knowledg	e of the subject area and transform	i it to new questions.	They are capable, in
	targets for new application or research orient	r learning level and define further step	tial social economic and	cultural impact
	targets for new application-or research-orien	ed duties in accordance with the poten		cultural impact.
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Water and The	neral Bioprocess Engineering: Elective	Compulsory	
i onowing curricula	Energy and Environmental Engineering. Specialisation A - Ge	ialisation Energy and Environmental Fr	aineerina: Elective Comm	ulsorv
	International Management and Engineering: 9	Specialisation II. Process Engineering ar	nd Biotechnology: Elective	e Compulsory
	International Management and Engineering:	Specialisation II. Renewable Energy: Ele	ctive Compulsory	-
	Renewable Energies: Specialisation Bioenerg	y Systems: Elective Compulsory		
	Process Engineering: Specialisation Chemical	Process Engineering: Elective Compuls	ory	
	Process Engineering: Specialisation Process E	ngineering: Elective Compulsory		
	Process Engineering: Specialisation Environm	ental Process Engineering: Elective Cor	mpulsory	
	water and Environmental Engineering: Specie	alisation Environment: Compulsory		
	water and Environmental Engineering: Speck	ansation cities. Elective Compulsory		

Course L0052: Solid Matter Process Technology for Biomass		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Werner Sitzmann	
Language	DE	
Cycle	SoSe	
Content	The industrial application of unit operations as part of process engineering is explained by actual examples of solid biomass	
	processes. Size reduction, transportation and dosing, drying and aggiomeration of renewable resources are described as important	
	products. Aspects of explosion protection and plant design complete the lecture.	
Literature	Kaltschmitt M., Hartmann H. (Hrsg.): Energie aus Bioamsse, Springer Verlag, 2001, ISBN 3-540-64853-4	
	Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz, Schriftenreihe Nachwachsende Rohstoffe,	
	Fachagentur Nachwachsende Rohstoffe e.V. www.nachwachsende-rohstoffe.de	
	Bockisch M.: Nahrungsfette und -öle, Ulmer Verlag, 1993, ISBN 380000158175	

Course L0320: Thermal Wast	te Treatment
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Kerstin Kuchta
Language	EN
Cycle	SoSe
Content	 Introduction, actual state-of-the-art of waste incineration, aims. legal background, reaction principals basics of incineration processes: waste composition, calorific value, calculation of air demand and flue gas composition Incineration techniques: grate firing, ash transfer, boiler Flue gas cleaning: Volume, composition, legal frame work and emission limits, dry treatment, scrubber, de-nox techniques, dioxin elimination, Mercury elimination Ash treatment: Mass, quality, treatment concepts, recycling, disposal
Literature	Thomé-Kozmiensky, K. J. (Hrsg.): Thermische Abfallbehandlung Bande 1-7. EF-Verlag für Energie- und Umwelttechnik, Berlin, 196 - 2013.

Course L1177: Thermal Waste Treatment	
Тур	Recitation Section (large)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Kerstin Kuchta
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0827: Mode	ling in Water Management			
Courses				
Title		Typ	Hrs/wk	CP
Groundwater Modeling using Modfl	ow (L0543)	Lecture	1	1
Groundwater Modeling using Modfl	ow (L0544)	Recitation Section (small)	2	2
Modeling of Water Supply and Sew	er Network (L0875)	Project-/problem-based Learning	2	3
Module Responsible	Dr. Klaus Johannsen			
Admission Requirements	None			
Recommended Previous	Groundwater			
Knowledge	- aroundwater budraulics and transport of subsi			
	groundwater hydraulics and transport of substances			
	Pipe Systems			
	 Knowledge on urban water infrastructures, 	in particular drinking water systemsand ι	ırban draina	ge systems including
	special structures			
	 Hydraulics of drinking water supply systems a 	nd sewer systems		
	Basic knowledge on water management			
Educational Objectives	After taking part successfully, students have reached	I the following learning results		
Professional Competence				
Knowledge	The students are able to describe the modelling of g	oundwater flow and transport as well as urb	an water infi	rastructures. They car
	carry out systems analyses and can detect technical	and conceptual weak points within the sys	tems in case	studies. Besides they
	are able to analyse interdependencies of hydraulic a	nd toxic phenomena in soil and water.		
Skills	The students are able to construct and apply scient	ific aroundwater models indipendently. The	v can work (on different scenarios
	and can compare or assess different solutions for ex	sting problems by application of selected so	oftware produ	ucts. The students are
	able to use different software solutions (e.g. EPANET	, ЕРА-SWMM).		
Deveenal Commetence				
	Wird night vormittalt			
Social Competence	wird nicht vermitteit.			
Autonomy	Wird nicht vermittelt.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70		
Credit points	6	-		
Course achievement	None			
Examination	Oral exam			
Examination duration and	20 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineeri	ng: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engine	ering: Elective Compulsory		
-	Civil Engineering: Specialisation Coastal Engineering	Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: E	ective Compulsory		
	Water and Environmental Engineering: Specialisatior	Water: Compulsory		
	Water and Environmental Engineering: Specialisation	Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisatior	Cities: Elective Compulsory		

Course L0543: Groundwater Modeling using Modflow		
Тур	Lecture	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Sonja Götz	
Language	DE/EN	
Cycle	SoSe	
Content	Introduction and application of the groundwater model MODFLOW (PMWIN); theoretical backround of the modell, students do work	
	with the model PMWIN for practical case studies.	
Literature	MODFLOW-Handbuch	
	Chiang, Wen Hsien: PMWIN	

Course L0544: Groundwater Modeling using Modflow	
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Sonja Götz
Language	DE/EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0875: Modeling of Water Supply and Sewer Network		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Dr. Klaus Johannsen, Weitere Mitarbeiter	
Language	DE	
Cycle	SoSe	
Content		
Literature	Mutschmann/Stimmelmayr: Taschenbuch der Wasserversorgung, 16. Auflage. Springer Vieweg - Verlag. Wiesbaden 2014.	

Module M0870: Mana	gement of Surface Water			
Courses				
Title		Түр	Hrs/wk	СР
Modelling of Flow in Rivers and Est	uaries (L0810)	Lecture	3	4
Nature-Oriented Hydraulic Enginee	ring / Integrated Flood Protection (L0961)	Project-/problem-based Learning	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Fundamentals of Hydromechanics, Hydraulics,	Hydrology and Hydraulic Engineering; Hydrau	ulic Engineer	ing I and Hydraulic
Knowledge	Engineering II			
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge	Students are able to define in detail the basic	c processes that are related to the modelling of	of flows in hy	ydraulic engineering.
	Besides, they can describe the basic aspects of	numerical modelling and actual numerical mode	els for the sin	nulation of flows and
	waves. They can also depict the concepts of nat	ure oriented hydraulic engineering.		
Chille	Students are able to apply bydrodynamic pump	ical models to practical hydraulis engineering to	alka Eurthorm	are the students are
SKIIIS	able to set up flood-risk management concepts	and are able to apply bacic concepts of repaturat	ion to practic	al problems
	able to set up nood-lisk management concepts			ai problems.
Personal Competence				
Social Competence	The students are able to deploy their gained kr	nowledge in applied problems of the practical na	ture-based h	ydraulic engineering.
	Additionaly, they will be able to work in team wi	th engineers of other disciplines.		
Autonomy	The students will be able to independently exter	nd their knowledge and apply it to new problems.		
Workload in Hours	Independent Study Time 110, Study Time in Lec	ture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 150 min. T	he examination includes tasks with respect to	the general ι	understanding of the
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Water and Traff	ic: Compulsory		
Following Curricula	Environmental Engineering: Core Qualification: I	Elective Compulsory		
	Joint European Master in Environmental Studies	- Cities and Sustainability: Core Qualification: Cor	mpulsory	
	Water and Environmental Engineering: Specialis	ation Water: Compulsory		
	Water and Environmental Engineering: Specialis	ation Environment: Compulsory		
	Water and Environmental Engineering: Specialis	ation Cities: Elective Compulsory		

Course L0810: Modelling of F	Flow in Rivers and Estuaries
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Dr. Edgar Nehlsen, Prof. Peter Fröhle
Language	DE/EN
Cycle	SoSe
Content	Basics of numerial models / application of models
	 classification of models model concept modelling 1D Working Equation Mathematical description of physical processes Equation of motions conservation of mass conservation of momentum Initial conditions and boundary conditions Numerical Methods Time step procedure Finite differences Finite volumes
Literature	Vorlesungsskript
Literature	Tonobangbon p

Course L0961: Nature-Orient	ted Hydraulic Engineering / Integrated Flood Protection
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Natasa Manojlovic, Prof. Peter Fröhle
Language	DE/EN
Cycle	SoSe
Content	 Regime-Theory and application for the development of environmental guiding priciples of rivers Engineering - biological measures for the stabilization of rivers Risk management in flood protection Design techniques in technical flood protection Methods for the assessment of flood caused damages
Literature	Vorlesungsumdruck

Module M0860: Harbo	our Engineering and Harbour Planning	1		
Courses				
Title Harbour Engineering (L0809) Harbour Engineering (L1414)		Typ Lecture Project-/problem-based Learning	Hrs/wk 2 1	CP 2 2
Port Planning and Port Construction	n (L0378)	Lecture	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous	Basics of coastal engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reached t	he following learning results		
Professional Competence				
Knowledge	The students are able to define in details and to choo	se design approaches for the functional d	esign of a po	rt and apply them to
	design tasks. They can design the fundamental elemer	its of a port.		
Skills	The students are able to select and apply appropriate approaches for the functional design of ports.			
Personal Competence				
Social Competence	The students are able to deploy their gained knowled	ge in applied problems such as the funct	ional design	of ports. Additionaly,
	they will be able to work in team with engineers of othe	er disciplines.		
Autonomy	The students will be able to independently extend their	knowledge and apply it to new problems.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70)		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 150 min. The examination	mination includes tasks with respect to	the general u	understanding of the
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Structural Engineering	: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineer	ing: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: C	Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elec	tive Compulsory		
	International Management and Engineering: Specialisa	tion II. Civil Engineering: Elective Compuls	ory	
	Theoretical Mechanical Engineering: Technical Complete	mentary Course: Elective Compulsory		

Course L0809: Harbour Engineering	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	SoSe
Content	 Fundamentals of harbor engineering Maritime transportation and waterways engineering Ships Elements of harbors Harbor approaches and water-side harbor areas Terminal design and handling of cargo Quay-walls and piers Equipment of harbors Sluices and other special constructions Connection to inland transportation / inland waterway transportation Protection of harbors Breakwaters and Jetties Wave protection of harbors Fishery and other small harbors
Literature	Brinkmann, B.: Seehäfen, Springer 2005

Course L1414: Harbour Engineering	
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0378: Port Planning	and Port Construction
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Frank Feindt
Language	DE
Cycle	SoSe
Content	 Planning and implementation of major projects Market analysis and traffic relations Planning process and plan Port planning in urban neighborhood Development of the logistics center "Port of Hamburg" in the metropolis Quays and waterfront structure Special planning Law Harbor - securing of a flexible use of the port Dimensioning of quays Flood protection structures Port of Hamburg - Infrastructure and development Preparation of areas Scour formation in front of shore structures
Literature	Vorlesungsumdruck, s. www.tu-harburg.de/gbt
Literature	 Dimensioning of quays Flood protection structures Port of Hamburg - Infrastructure and development Preparation of areas Scour formation in front of shore structures Vorlesungsumdruck, s. www.tu-harburg.de/gbt

Module M0857: Geocl	nemical Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Contaminated Sites and Landfilling	(L0906)	Lecture	2	2
Contaminated Sites and Landfilling	(L0907)	Recitation Section (large)	1	2
Geochemical Engineering (L0904)		Lecture	2	2
Module Responsible	Dr. Marco Ritzkowski			
Admission Requirements	None			
Recommended Previous	Module: General and Inorganic Chemistry,			
Knowledge	Module:Organic Chemistry,			
	Biology (Basic Knowledge)			
Educational Objectives	After taking part successfully, students have reach	ed the following learning results		
Professional Competence				
Knowledge	With the completion of this module students acqu	uire profound knowledge of biogeochemica	l processes, the	fate of pollutants in
	soil and groundwater, and techniques to deposit co	ontaminated waste material. They are able	to describe in pri	inciple the behaviour
	of chemicals in the environment. Students can exp	lain and report the approach to remediate	contaminated sit	es.
Skills	With the completion of this module students can	apply the acquired theoretical knowledge	to model cases	of site pollution and
SKIIS	critically assess the situation technically and conc	entually. They are able to draw comparisor	is on different re	mediation strategies
	and techniques. Model projects can be devised and	I treated	is on uncreacte	filediation strategies
	and certifiques. Hodel projects can be devised and			
Personal Competence				
Social Competence	Students can discuss technical and scientific tasks	within a seminar subject specific and inter	disciplinary .	
Autonomy	Students can independently exploit sources , acqui	ire the particular knowledge of the subject	and apply it to ne	ew problems.
Workload in Hours	Independent Study Time 110, Study Time in Lectur	re 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	2 hours			
scale				
Assignment for the	Civil Engineering: Specialisation Water and Traffic:	Elective Compulsory		
Following Curricula	Environmental Engineering: Core Qualification: Electronic Electron	ctive Compulsory		
	Water and Environmental Engineering: Specialisati	on Water: Elective Compulsory		
	Water and Environmental Engineering: Specialisati	on Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisati	on Cities: Elective Compulsory		

Course L0906: Contaminated Sites and Landfilling		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Marco Ritzkowski, Dr. Joachim Gerth	
Language	EN	
Cycle	SoSe	
Content	The part Contaminated Sites gives an introduction into different scales of pollution and identifies key pollutants. Geochemical attenuation mechanisms and the role of organisms are highlighted affecting the fate of pollutants in leachate and groundwater. Techniques for site characterization and remediation are discussed including economical aspects. The part Landfilling is introduced by discussing fundamental aspects and the worldwide situation of waste management. The lecture highlights transformation processes in landfill bodies, emissions of gases and leachate, and the long-term behaviour of landfill sites with measures of aftercare.	
Literature	 Waste Management. Bernd Bilitewski; Georg Härdtle; Klaus Marek (Eds.), ISBN: 9783540592105, Springer Verlag Lehrbuchsammlung der TUB, Signatur USH-305 Solid Waste Technology and Management. Thomas Christensen (Ed.), ISBN: 978-1-4051-7517-3, Wiley Verlag Lesesaal 2: US - Umweltschutz, Signatur USH-332 Natural attenuation of fuels and chlorinated solvents in the subsurface. Todd H. Wiedemeier(Ed.), ISBN: 0471197491 Lesesaal 2: US - Umweltschutz, Signatur USH-844 	

Course L0907: Contaminated Sites and Landfilling	
Тур	Recitation Section (large)
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Dr. Marco Ritzkowski, Dr. Joachim Gerth
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0904: Geochemical	Engineering
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Joachim Gerth
Language	EN
Cycle	SoSe
Content	As an introduction cases are presented in which geochemical engineering was used to solve environmental problems. Environmentally important minerals are discussed and methods for their detection. It is demonstrated how solution equilibria can be modified to eliminate elevated concentrations of unwanted species in solution and how carbon dioxide concentration affects pH and the dissolution of carbonate minerals. Modifications of redox conditions, pH, and electrolyte concentration are shown to be effective tools for controlling the mobility and fate of hazardous species in the environment.
Literature	Construction and a disting C. A. I. Analy, D. Darbar
	Beochemistry, groundwater and pollution. C. A. J. Appelo; D. Postma
	Leiden [u.a.] Balkema 2005
	Lehrbuchsammlung der TUB, Signatur GWC-515

Modulo M1350: Exca	ation Law and Projects			
Module M1550. EXcav	ation Law and Projects			
Courses				
Title		Тур	Hrs/wk	СР
Subsoil and Underground Engineer	ng Law (L0395)	Lecture	2	2
Service Contract and Procurement	.aw (L1906)	Lecture	2	2
Project Geotechnics (L0708)		Project-/problem-based Learning	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fol	llowing learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and	30 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Electiv	ve Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: I	Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Elec	tive Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective	Compulsory		

Course L0395: Subsoil and Underground Engineering Law		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Günther Schalk	
Language	DE	
Cycle	WiSe	
Content	History of Civil Engineering Law (from 1700 BC to 2000 AD)	
	• Basics of foundation and excarvation law / engineering law (the participants in the case law of geotechnical law case studies)	
	• Legal aspects of technical regulations in civil engineering (with case studies)	
	• The civil engineering contract (including checklists for the special civil engineering contract design and execution)	
	• The liability of the planner and entrepreneur in civil engineering (practical examples, jurisprudence and law, inter alia, to the Ordinance on Combatants, liability for defects and traffic safety obligations, construction law and insurance questions)	
	• The ground / foundation risk and the systemic risk (also in the European context)	
	• The total debt in (low) building law (based on practice-oriented case constellations)	
	• The (construction) conflict, the dispute avoidance models and the construction process (practice-oriented presentation)	
Literature	Folienskript (in der Vorlesung erhältlich)	
	weitere Literatur:	
	Englert, Grauvogel und Maurer: Handbuch des Baugrund- und Tiefbaurechts. Werner-Verlag	

Course L1906: Service Contract and Procurement Law	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Günther Schalk, Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	
Literature	

Module Manual M.Sc. "Civil Engineering"

Course L0708: Project Geote	chnics
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	The students solve independently a project-based geotechnical problem in groups. Additional lectures concerning the problem will
	be held and material will be distributed as study basis. Every two weeks the groups present their current project status. The final
	work will be presentated in a final presentation.
Literature	abhängig von der Fragestellung

Module M1716: Subs	urface Processes			
Courses				
Title		Tun	Hrc/wk	CP
Intel		l ecture	7	2
Modeling of Subsurface Processes	(L2731)	Recitation Section (small)	1	1
Modern Techniques for Subsurface	Solute Transport (L2728)	Lecture	2	2
Modern Techniques for Subsurface	Solute Transport (L2729)	Recitation Section (large)	1	1
Module Responsible	Prof. Nima Shokri			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have re	ached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lect	ture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engi	neering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical E	ngineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engine	ering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traf	fic: Elective Compulsory		
	Process Engineering: Specialisation Environmer	ntal Process Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process Eng	gineering: Elective Compulsory		
	Water and Environmental Engineering: Speciali	sation Water: Compulsory		
	Water and Environmental Engineering: Speciali	sation Environment: Elective Compulsory		
	Water and Environmental Engineering: Speciali	sation Cities: Elective Compulsory		

Course L2730: Modeling of Subsurface Processes	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Sonja Götz
Language	EN
Cycle	WiSe
Content	
Literature	

Course L2731: Modeling of Subsurface Processes	
Тур	Recitation Section (small)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Sonja Götz
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L2728: Modern Techniques for Subsurface Solute Transport	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Nima Shokri
Language	EN
Cycle	WiSe
Content	
Literature	

Course L2729: Modern Techniques for Subsurface Solute Transport	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Hannes Nevermann
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Courses				
Title		Тур	Hrs/wk	СР
Microplastics in Environment (L275	0)	Integrated Lecture	2	2
Research Methods for Energy-Water-Soil-Climate Nexus (L2751)		Lecture	1	2
Research Trends in Energy-Water-S	oil-Climate Nexus (L2752)	Seminar	2	2
Module Responsible	Prof. Nima Shokri			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Report (about 5-10 pages) and Presentation (about 15 min)		
scale				
Assignment for the	Civil Engineering: Specialisation Water and T	raffic: Elective Compulsory		
Following Curricula	Environmental Engineering: Specialisation Wa	ater: Elective Compulsory		
	Environmental Engineering: Specialisation Wa	aste and Energy: Elective Compulsory		
	Environmental Engineering: Specialisation Bio	otechnology: Elective Compulsory		
	Water and Environmental Engineering: Specia	alisation Cities: Elective Compulsory		
	Water and Environmental Engineering: Specia	alisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Specia	alisation Water: Elective Compulsory		

Course L2750: Microplastics in Environment	
Тур	Integrated Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Nima Shokri
Language	EN
Cycle	WiSe
Content	
Literature	

Course L2751: Research Methods for Energy-Water-Soil-Climate Nexus	
Тур	Lecture
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Nima Shokri
Language	EN
Cycle	WiSe
Content	
Literature	

Course L2752: Research Trends in Energy-Water-Soil-Climate Nexus				
Тур	Seminar			
Hrs/wk	2			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Lecturer	Dr. Salome Shokri-Kuehni			
Language	EN			
Cycle	WiSe			
Content				
Literature				
Module M1437: Non o	lestructive testing of materials and parts			
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Courses				
Title		Тур	Hrs/wk	СР
Non destructive testing of material	s and parts (L2215)	Lecture	2	2
Non destructive testing of material	s and parts (L2217)	Project-/problem-based Learning	3	3
Non destructive testing of material	s and parts (L2216)	Recitation Section (large)	1	1
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	wing learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Written document about theory and praxis			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Elective	Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Elective	Compulsory		
	Civil Engineering: Specialisation Geotechnical Engineering: Ele	ctive Compulsory		
	Civil Engineering: Specialisation Geotechnical Engineering: Ele	ctive Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Elective	ve Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Elective	ve Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Co	mpulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Co	mpulsory		
	Materials Science: Specialisation Engineering Materials: Elective	ve Compulsory		

Course L2215: Non destructi	ve testing of materials and parts
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Marcus Rutner, Prof. Robert Meißner
Language	DE/EN
Cycle	WiSe
Content	This strongly interdisciplinary lecture and practical course is offered to Masterstudents who are interesed to learn about an
	important field across engineering and material science industries, i.e. nondestructive testing of materials and parts.
	Interdisciplinary approaches and thinking becomes more and more important since many problems extend into various disciplines,
	hence, can only be solved through interdisciplinary thinking and collaboration. Accordingly, this module combines the efforts of 4
	different disciplines, i.e. mechanical engineering, civil engineering, materials science and computer science with a touch of
	electrical engineering. Nondestructive testing (NDT) is the process of inspecting, testing, and evaluating materials, parts, and
	assemblies to understand properties and defects without causing damage to the material or part. This scientific approach enables
	to make intrinsic material and component characteristics visible. Hence, the approach links detection approaches (e.g. linear and
	nonlinear acoustic methods, ultrasonic testing, Magnetic Particle Testing, thermo-chemical methods, etc.) with material physics
	and the mechanics of components, further, with evaluation, interpretation, big data management, transmission of data, and
	cybersecurity. The module embraces a lecture and a practical course. Contents of the lecture are NTD technologies and their
	theory behind, evaluation, transmission of data, while the students will apply the NDT technologies during the practical course in
	the experimental test halls and labs at TUHH. Lecture and practical course split into the major themes: A) Detection: Theory and
	Practice B) Evaluation of Data: Theory and Practice C) Data Acquisition and Transmission with Wireless, Batteryless Sensor
	Devices:Theory and Practice
Literature	

Course L2217: Non destructi	Course L2217: Non destructive testing of materials and parts	
Тур	Project-/problem-based Learning	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Marcus Rutner, Prof. Robert Meißner	
Language	DE/EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L2216: Non destructi	ve testing of materials and parts
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Marcus Rutner, Prof. Robert Meißner
Language	DE/EN
Cycle	WiSe
Content	This strongly interdisciplinary lecture and practical course is offered to Masterstudents who are interesed to learn about an
	important field across engineering and material science industries, i.e. nondestructive testing of materials and parts.
	Interdisciplinary approaches and thinking becomes more and more important since many problems extend into various disciplines,
	hence, can only be solved through interdisciplinary thinking and collaboration. Accordingly, this module combines the efforts of 4
	different disciplines, i.e. mechanical engineering, civil engineering, materials science and computer science with a touch of
	electrical engineering. Nondestructive testing (NDT) is the process of inspecting, testing, and evaluating materials, parts, and
	assemblies to understand properties and defects without causing damage to the material or part. This scientific approach enables
	to make intrinsic material and component characteristics visible. Hence, the approach links detection approaches (e.g. linear and
	nonlinear acoustic methods, ultrasonic testing, Magnetic Particle Testing, thermo-chemical methods, etc.) with material physics
	and the mechanics of components, further, with evaluation, interpretation, big data management, transmission of data, and
	cybersecurity. The module embraces a lecture and a practical course. Contents of the lecture are NTD technologies and their
	theory behind, evaluation, transmission of data, while the students will apply the NDT technologies during the practical course in
	the experimental test halls and labs at TUHH. Lecture and practical course split into the major themes: A) Detection: Theory and
	Practice B) Evaluation of Data: Theory and Practice C) Data Acquisition and Transmission with Wireless, Batteryless Sensor
	Devices:Theory and Practice
Literature	

Module M0949: Rural	Development and Resources Oriented	Sanitation for diffe	rent Climate Zon	es
Courses				
Title Rural Development and Resources	Oriented Sanitation for different Climate Zones (L0942)	Typ Seminar	Hrs/wk	CP 3
Madula Development and Resources	Dref, Dalf Ottorpabl	Lecture	Z	5
Module Responsible				
Admission Requirements	None	ty call degradation lack of w	ator recourses and capita	tion
Kecommended Previous	basic knowledge of the global situation with fising pover	ty, soli degradation, lack of w	ater resources and samita	ition
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence	After taking part successiony, students have reached th	c following learning results		
Knowledge	Students can describe resources oriented wastewater techniques designed for reuse of water, nutrients and so Students are able to discuss a wide range of proven app	systems mainly based on sou il conditioners. roaches in Rural Developmen	irce control in detail. The	ey can comment on ons of the world.
Skills	Students are able to design low-tech/low-cost sanitati rehabilitation of top soil quality combined with food and "Holisitc Planned Grazing" as developed by Allan Savory	on, rural water supply, rainv water security. Students can r.	vater harvesting systems consult on the basics of s	s, measures for the soil building through
Personal Competence				
Social Competence	The students are able to develop a specific topic in a tea	am and to work out milestones	s according to a given pla	n.
Autonomy	Students are in a position to work on a subject and t subject.	o organize their work flow in	idependently. They can a	also present on this
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	During the course of the semester, the students work t	owards mile stones. The work	includes presentations a	and papers. Detailed
scale	information will be provided at the beginning of the sme	ster.		
Assignment for the	Civil Engineering: Specialisation Water and Traffic: Elect	ive Compulsory		
Following Curricula	Bioprocess Engineering: Specialisation A - General Biopr	ocess Engineering: Elective Co	ompulsory	
	Chemical and Bioprocess Engineering: Specialisation Ge	neral Process Engineering: Ele	ective Compulsory	
	Environmental Engineering: Specialisation Water: Elective	ve Compulsory		
	International Management and Engineering: Specialisati	on II. Energy and Environment	tal Engineering: Elective (Compulsory
	Joint European Master in Environmental Studies - Cities	and Sustainability: Specialisat	ion Water: Elective Comp	ulsory
	Process Engineering: Specialisation Environmental Proce	ess Engineering: Elective Com	pulsory	
	Process Engineering: Specialisation Process Engineering	: Elective Compulsory		
	water and Environmental Engineering: Specialisation W	ater: Elective Compulsory		
	water and Environmental Engineering: Specialisation En	vironment: Elective Compulso	ory	
	water and Environmental Engineering: Specialisation Ci	ties: Elective Compulsory		

Course L0942: Rural Develop	ment and Resources Oriented Sanitation for different Climate Zones
Тур	Seminar
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	WiSe
Content	
	 Central part of this module is a group work on a subtopic of the lectures. The focus of these projects will be based on an interview with a target audience, practitioners or scientists. The group work is divided into several Milestones and Assignments. The outcome will be presented in a final presentation at the end of the semester.
Literature	 J. Lange, R. Otterpohl 2000: Abwasser - Handbuch zu einer zukunftsfähigen Abwasserwirtschaft. Mallbeton Verlag (TUHH Bibliothek) Winblad, Uno and Simpson-Hébert, Mayling 2004: Ecological Sanitation, EcoSanRes, Sweden (free download) Schober, Sabine: WTO/TUHH Award winning Terra Preta Toilet Design: http://youtu.be/w_R09cYq6ys

Course L0941: Rural Develop	ment and Resources Oriented Sanitation for different Climate Zones
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	WiSe
Content	 Living Soil - THE key element of Rural Development Participatory Approaches Rainwater Harvesting Ecological Sanitation Principles and practical examples Permaculture Principles of Rural Development Performance and Resilience of Organic Small Farms Going Further: The TUHH Toolbox for Rural Development EMAS Technologies, Low cost drinking water supply
Literature	 Miracle Water Village, India, Integrated Rainwater Harvesting, Water Efficiency, Reforestation and Sanitation: http://youtu.be/9hmkgn0nBgk Montgomery, David R. 2007: Dirt: The Erosion of Civilizations, University of California Press

Module M0619: Waste	e Treatment Tech	nologies				
Courses						
Title				Тур	Hrs/wk	СР
Waste and Environmental Chemistr	ry (L0328)			Practical Course	2	2
Biological Waste Treatment (L0318)			Project-/problem-based Learning	3	4
Module Responsible	Prof. Kerstin Kuchta					
Admission Requirements	None					
Recommended Previous	chemical and biological b	asics				
Knowledge						
Educational Objectives	After taking part success	fully, students have re	eached the followi	ng learning results		
Professional Competence						
Knowledge	The module aims possess	knowledge concerni	ng the planning of	biological waste treatment plan	ts. Students ar	e able to explain the
	design and layout of anal	erobic and aerobic wa	aste treatment pla	nts in detail, describe different t	echniques for v	waste gas treatment
	plants for biological wast	e treatment plants an	ia explain differen	t methods for waste analytics.		
Skille	The students are able to	discuss the compilati	on of docign and l	avout of plants. They can critical	ly ovaluato to	shpiques and quality
JKIIIS	control measurements. T	he students can rech	erché and evalua	te literature and date connected	to the tasks	aiven in der module
	and plan additional tests.	They are capable of	reflecting and eva	luating findings in the group.		given in der module
		.,	j.	5 5 5 5 5 5 5 5 5		
Personal Competence						
Social Competence	Students can participate	in subject-specific ar	nd interdisciplinar	y discussions, develop cooperate	ed solutions ar	nd defend their own
	work results in front of	others and promote	the scientific dev	elopment in front of colleagues	. Furthermore,	they can give and
	accept professional const	ructive criticism.				
Autonomy	Students can independer	ntly tap knowledge fr	om literature, bus	iness or test reports and transfo	orm it to the co	ourse projects. They
	are capable, in consultati	on with supervisors a	s well as in the int	erim presentation, to assess the	ir learning leve	el and define further
	steps on this basis. Furth	ermore, they can de	fine targets for ne	ew application-or research-orien	ted duties in a	accordance with the
	potential social, economi	c and cultural impact.				
Maddaad in Harris	Jandara and ant Church - Times	110 Chudu Time in Lu				
Credit points		110, Study Time in Le	ecture 70			
Course achievement	O Compulsory Bonus Fo	rm	Description			
course achievement	Yes None Su	bject theoretical	and			
	pr	actical work				
Examination	Presentation					
Examination duration and	Elaboration and Presenta	tion (15-25 minutes ii	n groups)			
scale						
Assignment for the	Civil Engineering: Special	isation Structural Eng	jineering: Elective	Compulsory		
Following Curricula	Civil Engineering: Special	isation Geotechnical	Engineering: Elect	ive Compulsory		
	Civil Engineering: Special	isation Coastal Engin	eering: Elective Co	ompulsory		
	Civil Engineering: Special	isation Water and Tra	affic: Elective Com	pulsory		
	Energy and Environment	al Engineering: Specia	alisation Environm	ental Engineering: Elective Com	oulsory	
	International Managemer	ig: Core Qualification	: Compulsory	argy and Environmental Enginee	ring: Elective (Compulson
	loint European Master in	Environmental Studie	s - Cities and Sust	ainability: Specialisation Energy	Flective Com	oulsory
	Water and Environmenta	Engineering: Special	lisation Cities: Elec	tive Compulsory	Licenve com	Subory
	Water and Environmenta	Engineering: Special	lisation Environme	nt: Elective Compulsory		

Course L0328: Waste and En	vironmental Chemistry
Тур	Practical Course
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Kerstin Kuchta
Language	DE/EN
Cycle	WiSe
Content	The participants are divided into groups. Each group prepares a transcript on the experiment performed, which is then used as basis for discussing the results and to evaluate the performance of the group and the individual student. In some experiments the test procedure and the results are presented in seminar form, accompanied by discussion and results evaluation. Experiments ar e.g. Screening and particle size determination Fos/Tac AAS Chalorific value
Literature	Scripte

Course L0318: Biological Wa	ste Treatment
Тур	Project-/problem-based Learning
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Kerstin Kuchta
Language	EN
Cycle	WiSe
Content	 Introduction biological basics determination process specific material characterization aerobic degradation (Composting, stabilization) anaerobic degradation (Biogas production, fermentation) Technical layout and process design Flue gas treatment Plant design practical phase
Literature	

Module M0822: Proce	ss Modeling in Water Technolo	ду		
Courses				
Title		Тур	Hrs/wk	СР
Process Modelling of Wastewater T	reatment (L0522)	Project-/problem-based Learning	2	3
Process Modeling in Drinking Water	r Treatment (L0314)	Project-/problem-based Learning	2	3
Module Responsible	Dr. Klaus Johannsen			
Admission Requirements	None			
Recommended Previous	Knowledge of the most important processes in	n drinking water and waste water treatment.		
Knowledge				
Educational Objectives	After taking part successfully, students have r	eached the following learning results		
Professional Competence				
Knowledge	Students are able to explain selected proces basics as well as possibilities and limitations of	ses of drinking water and waste water treatment of dynamic modeling.	n detail. Th	ey are able to explair
Skills	Students are able to use the most important water and waste water treatment into a math They are able to set up and apply models and	features Modelica offers. They are able to transponted to transponted and the matical model in Modelica with respect to equilibulars and limitations.	ose selected rium, kinetio	processes in drinking to and mass balances
Personal Competence Social Competence	Students are able to solve problems and doct able to give appropriate feedback and can wo	ument solutions in a group with members of differe rk constructively with feedback concerning their wo	nt technical ork.	background. They are
Autonomy	Students are able to define a problem, gain th	e required knowledge and set up a model.		
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	1,5 hours			
scale				
Assignment for the	Civil Engineering: Specialisation Water and Tr	affic: Elective Compulsory		
Following Curricula	Environmental Engineering: Specialisation Wa	ter: Elective Compulsory		
	Joint European Master in Environmental Studio	es - Cities and Sustainability: Specialisation Water:	Elective Com	pulsory
	Process Engineering: Specialisation Environme	ental Process Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process E	ngineering: Elective Compulsory		
	Water and Environmental Engineering: Specia	lisation Water: Elective Compulsory		
	Water and Environmental Engineering: Specia	lisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Specia	lisation Cities: Elective Compulsory		

Course L0522: Process Mode	Iling of Wastewater Treatment
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Joachim Behrendt
Language	DE/EN
Cycle	WiSe
Content	Mass and energy balances
	Tracer medelling
	Activated Sludge Model
	Wastewater Treatment Plant Modelling (continously and SBR)
	Sludge Treatment (ADM, aerobic autothermal)
	Biofilm Modelling
Literature	Henze, Mogens (Seminar on Activated Sludge Modelling, ; Kollekolle Seminar on Activated Sludge Modelling, ;)
	Activated sludge modelling : processes in theory and practice ; selected proceedings of the 5th Kollekolle Seminar on Activated
	Sludge Modelling, neid in Kollekolle, Denmark, 10 - 12 September 2001
	ILDINGOID : WAA PUDI, 2002
	Henze, mogens
	Watewater trastment - biological and chemical processor
	ISRN: 3540422285 (Pn.)
	Berlin (J. J. Springer, 2002
	TUB HH Katalog
	Wiesmann. Udo (Choi, In Su: Dombrowski, Eva-Maria:)
	Fundamentals of biological wastewater treatment
	ISBN: 3527312196 (Gb.) URL: http://deposit.ddb.de/cgi-bin/doksery?id=2774611&prov=M&dok_var=1&dok_ext=htm
	Weinheim : WILEY-VCH. 2007
	TUB HH Katalog

Course L0314: Process Mode	ling in Drinking Water Treatment
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Klaus Johannsen
Language	DE/EN
Cycle	WiSe
Content	In this course selected drinking water treatment processes (e.g. aeration or activated carbon adsorption) are modeled dynamically using the programming language Modelica, that is increasingly used in industry. In this course OpenModelica is used, an free access frontend of the programming language Modelica. In the beginning of the course the use of OpenModelica is explainded by means of simple examples. Together required elements and structure of the model are developed. The implementation in OpenModelica and the application of the model is done individually or in groups respectively. Students get feedback and can gain extra points for the exam.
Literature	 OpenModelica: https://openmodelica.org/index.php/download/download-windows OpenModelica - Modelica Tutorial: https://openmodelica.org/index.php/useresresources/userdocumentation OpenModelica - Users Guide: https://openmodelica.org/index.php/useresresources/userdocumentation Peter Fritzson: Principles of Object-Oriented Modeling and Simulation with Modelica 2.1,Wiley-IEEE Press, ISBN 0-471-471631. MHW (rev. by Crittenden, J. et al.): Water treatment principles and design. John Wiley & Sons, Hoboken, 2005. Stumm, W., Morgan, J.J.: Aquatic chemistry. John Wiley & Sons, New York, 1996. DVGW (Hrsg.): Wasseraufbereitung - Grundlagen und Verfahren. Oldenbourg Industrie Verlag, München, 2004.

Module M0620: Speci	al Aspects of V	Vaste Resource	Management			
Courses						
Title				Тур	Hrs/wk	СР
Advanced Topics in Waste Resourc	e Management (L1055)			Project-/problem-based Learning	3	3
International Waste Management (L0317)			Project-/problem-based Learning	2	3
Module Responsible	Prof. Kerstin Kuchta					
Admission Requirements	None					
Recommended Previous	basics in waste treat	ment technologies				
Knowledge						
Educational Objectives	After taking part suc	cessfully, students have	e reached the followi	ng learning results		
Professional Competence						
Knowledge	The students are ab from waste in detail.	le to describe waste as This covers collection,	a resource as well transport, treatment	as advanced technologies for re and disposal in national and int	ecycling and re ernational con	ecovery of resources texts.
Skills	Students are able to select suitable processes for the treatment with respect to the national or cultural and developmental context. They can evaluate the ecological impact and the technical effort of different technologies and management systems.					
Personal Competence						
Social Competence	Students can work t	together as a team of	2-5 persons, partici	pate in subject-specific and inte	erdisciplinary	discussions, develop
	cooperated solutions and defend their own work results in front of others and promote the scientific development of colleagues.					
	Furthermore, they ca	an give and accept prof	essional constructive	e criticisms.		_
Autonomy	Students can inden	andently gain addition:	al knowledge of the	subject area and apply it in su	lving the give	on course tasks and
hatohomy	projects	chaenery gain addition	an knowledge of the	Subject and apply it in st	siving the give	
	projects.					
Workload in Hours	Independent Study T	ime 110, Study Time ir	n Lecture 70			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	Yes 20 %	Written elaboration				
Examination	Presentation					
Examination duration and	PowerPoint presenta	tion (10-15 minutes)				
scale						
Assignment for the	Civil Engineering: Sp	ecialisation Water and	Traffic: Elective Com	pulsory		
Following Curricula	Environmental Engin	eering: Specialisation V	Vaste and Energy: El	ective Compulsory		
	Joint European Maste	er in Environmental Stu	dies - Cities and Sust	ainability: Specialisation Energy	: Elective Com	ipulsory
	Water and Environm	ental Engineering: Spe	cialisation Water: Ele	ctive Compulsory		
	Water and Environm	ental Engineering: Spec	cialisation Environme	ent: Elective Compulsory		
	Water and Environm	ental Engineering: Spe	cialisation Cities: Ele	ctive Compulsory		
L		5 5 1				

Course L1055: Advanced Top	oics in Waste Resource Management
Тур	Project-/problem-based Learning
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Rüdiger Siechau
Language	EN
Cycle	WiSe
Content	 Focus of the course "Advanced topics of waste resource management" lies on the organisational structures in waste management - such as planning, financing and logistics. One excursion will be offered to take part in (incineration plant, vehicle fleet and waste collection systems). The course is split into two parts: part: "Conventional" lecture (development of waste management, legislation, collection, transportation and organisation of waste management, costs, fees and revenues). part: Project base learning: You will get a project to work out in groups of 4 to 6 students; all tools and data you need to work out the project were given before during the conventional lecture. Course documents are published in StudIP and communication during project work takes place via StudIP. The results of the project work are presented at the end of the semester. The final mark for the course consists of the grade for the presentation.
Literature	Einfunrung in die Abfallwirtschaft; Martin Kranert, Klaus Cord-Landwehr (Hrsg.); Vieweg + Teubner Verlag; 2010 PowerPoint slides in Stud IP

Course L0317: International	Waste Management
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Kerstin Kuchta
Language	EN
Cycle	WiSe
Content	Waste avoidance and recycling are the focus of this lecture. Additionally, waste logistics (Collection, transport, export, fees and taxes) as well as international waste shipment solutions are presented. Other specific wastes, e.g. industrial waste, treatment concepts will be presented and developed by students themselves Waste composition and production on international level, wast eulogistic, collection and treatment in emerging and developing countries. Single national projects and studies will be prepared and presented by students
Literature	Basel convention

Module M0713: Concr	ete Structures	;				
Courses						
Title				Тур	Hrs/wk	СР
Concrete Structures (L0579)				Seminar	1	1
Structural Concrete Members (L057	77)			Lecture	2	3
Structural Concrete Members (L057	(8)			Recitation Section (large)	2	2
Module Responsible	Prof. Günter Rombac	h				
Admission Requirements	None					
Recommended Previous	Basics of structural a	analysis, conception a	nd dimensioning of str	uctural concrete		
Knowledge	Modules: Reinforced	Concrete Structures	L+II Structural Analysi	s I+II. Mechanics I+II		
	Modules. Reinforced					
Educational Objectives	After taking part suc	cessfully, students ha	ave reached the followi	ng learning results		
Professional Competence						
Knowledge	The students broade	n their skills in struct	ural engineering, espe	cially in the field of building	s (houses, roofs, ha	alls). They dispose o
	the knowledge for th	e conception and des	sign of concrete buildin	as and structural members	that are often used	d.
			j	5		
Skills	The students are able to apply procedures of the conception and dimensioning to to practical problems of structural engineering.					
	They are capable to draft concrete buildings and to design them for general action effects and to plan their detailing and					
	execution. Moreover, they can make design and construction sketches and draw up technical descriptions.					
Personal Competence						
Social Competence	The students are abl	e to obtain results of	high quality in teamwo	ork		
Social competence			ingi quanty in teamine			
Autonomy	The students are abl	e to carry out comple	ex conception and dime	ensioning tasks of structures	s under the guidance	ce of tutors.
Workload in Hours	Independent Study 7	ime 110. Study Time	in Lecture 70			
Credit points	6	,,				
Course achievement	Compulsory Bonus	Form	Description			
course achievement	Yes None	Presentation	Es werden 2	Referate ausgegeben		
Examination	Written exam					
Examination duration and	120 minutes					
scale						
Assignment for the	Civil Engineering: So	ecialisation Structura	l Engineering: Compul-	sorv		
Following Curricula	Civil Engineering: Sp	ecialisation Geotechn	nical Engineering: Elect	ive Compulsory		
. c	Civil Engineering: Sp	ecialisation Coastal F	naineerina: Elective Co	ompulsory		
	Civil Engineering: Sp	ecialisation Water and	d Traffic: Elective Com	pulsory		
	International Manage	ement and Engineerin	g: Specialisation II Civ	/il Engineering: Elective Cor	npulsory	
			.g. specialisation II. en	Engineering. Elective cor		

Course L0579: Concrete Stru	ictures
Тур	Seminar
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	WiSe
Content	With help of a project teamwork the subjects of the course "Concrete Structures" is practiced, discussed and presented.
Literature	- Projektbezogene Unterlagen werden abgegeben.

Course L0577: Structural Cor	icrete Members
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	WiSe
Content	 skyscrapers: structural elements actions on structrues bracing systems design orf slabs (line and point supported plates and floor slabs) membranes and deep beams folded plates and shells truss models reinforced and prestressed members
Literature	 Vorlesungsunterlagen können im STUDIP heruntergeladen werden Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003 Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012 Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalender 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992 Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin 1973 Schlaich J.; Schäfer K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721ff, Verlag Ernst & Sohn, Berlin, 1998 Dames KH.: Rohbauzeichnungen Bewehrungszeichnungen. Bauverlag, Wiesbaden 1997

ourse L0578: Structural Concrete Members			
Тур	Recitation Section (large)		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Günter Rombach		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M0722: Comp	utation	al Ana	lysis of Concre	ete Structures			
Courses							
Title					Тур	Hrs/wk	СР
Computational Analysis of Concrete	e Structures	(L0598)			Lecture	2	3
Computational Analysis of Concrete	e Structures	(L0599)			Recitation Section (large)	1	1
FE-Modeling of Concrete Structures	s (L0600)				Project-/problem-based Learning	2	2
Module Responsible	Prof. Günte	er Romba	ch				
Admission Requirements	None						
Recommended Previous	Basic know	vledge in	structural analysis an	d design of reinforced	concrete structures (beams, slab	s, shear walls).
Knowledge	Lectures '	Concrete	Structures I und II'				
	Lectures '	Structura	l Analysis I and II'				
	Lecture 'Co	oncrete S	tructures'				
Educational Objectives	After takin	g part su	ccessfully, students h	ave reached the followi	ng learning results		
Professional Competence							
Knowledge	The studer	The students know the problems of numerical modeling and design of an arbitrary concrete structure.					
Skills	The students can model and design an arbitrary concrete structure by means of a finite element software package.						
Demonst Commentered							
Personal Competence	T 1						
Social Competence	ine students can model and design in teamwork a real concrete structure by means of a finite element software package.						
Autonomy	The students can model and design a real concrete structure based on a finite element software package and discuss the problems						
	and results with other students.						
Werklood in Hours	Indonanda	nt Ctudu	Time 110 Study Time	a in Lastura 70			
Credit neinte	ridepende	nt Study	Time 110, Study Time	e în Lecture 70			
Credit points	0 Compulsory	Popus	Form	Description			
Course achievement	Yes	None	Attestation	Am Ende d	es Semster ist ein Tragsysten	n mit dem F	echenprogramm zu
	~~			modellieren			
	Yes	None	Excercises	Es ist ein Tra	gsystem mit TEDDY zu modellie	ren	
Examination	Oral exam			-			
Examination duration and	45 min						
scale							
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory						
Following Curricula	Civil Engin	eering: S	pecialisation Geotech	nical Engineering: Elect	ive Compulsory		
-	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory						
	Civil Engin	eering: S	pecialisation Water ar	nd Traffic: Elective Com	pulsory		

Course L0598: Computationa	I Analysis of Concrete Structures
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	WiSe
Content	 Modeling of beam and truss structures Discontinuity regions, like frame corners, openings, shear walls with large openings Bracing of high-rise buildings Modeling of bridges Nonlinear analysis Finite-Elemente-analysis of slabs: support conditions, singularity regions Finite-Elemente-Berechnungen of shear walls and deep beams: support condition, design Coupled systems Modeling of slab supported on beams Shell structures 3D building models Nonlinear analysis of slabs and shells Documentation
Literature	 Vorlesungsumdruck Rombach, G.A. (2007): Anwendung der Finite-Elemente-Methode im Betonbau. 2. Auflage, Verlag Ernst & Sohn, Berlin Rombach G.A. (2011): Finite-Element Design of Concrete Structures, 2nd edition, ICE publishing Hartmann, F., Katz, C. (2002): Statik mit finiten Elementen. Springer, Berlin

Course L0599: Computational Analysis of Concrete Structures		
Тур	Recitation Section (large)	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Günter Rombach	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0600: FE-Modeling of	of Concrete Structures
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Lukas Henze
Language	DE
Cycle	WiSe
Content	Finite Element Modeling and computational design of concrete structures by 'SOFiSTiK'
Literature	 Rombach G.: Anwendung der Finite - Elemente - Methode im Betonbau. 2. Auflage. Verlag Ernst & Sohn, Berlin, 2007 Rombach G.: Finite-Element Design of Concrete Structures. 2nd edition, ICE Publishing, London, 2011, ISBN 0 7277 32749 Rombach G.: EDV-unterstützte Berechnungen im Stahlbetonbau. in: "Stahlbetonbau aktuell 2014" (ed. Gorris A., Hegger J., Mark P.), Berlin 2014 (S. C1C.36)

Module M0963: Steel	and Composite Structures			
Courses				
Title Steel and Composite Structures (L1	1204)	Typ Lecture	Hrs/wk 2	CP 2
Steel and Composite Structures (L1 Steel Bridges (L1097)	(205)	Recitation Section (large) Lecture	2 2	2 2
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
Recommended Previous Knowledge	Basics of steel construction (i.e. Steel Structures I and II, BUBC)			
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence		5 5		
Knowledge	After successful completition, students can			
Skills	 describe the phenomenon of local buckling explain warping torsion illustrate the behaviour of composite structures specify the principles in design of composite sttructures sketch the contructions of steel and composite bridges After successful participation students are able to check stiffened and unstiffened plated structures recognize and verify warping tosion in strucures design composite structures design bridges and o perform the detailing 			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	independent Study Time 96, Study Time in Lecture 84			
Course achievement	0 None			
Evamination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Compul Civil Engineering: Specialisation Geotechnical Engineering: Elect Civil Engineering: Specialisation Coastal Engineering: Elective C Civil Engineering: Specialisation Water and Traffic: Elective Com	sory tive Compulsory ompulsory ipulsory		
	International Management and Engineering: Specialisation II. Cir	vil Engineering: Elective Com	oulsory	

Course L1204: Steel and Composite Structures		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Marcus Rutner	
Language	DE	
Cycle	WiSe	
Content	 Local-buckling of plated structures Warping torsion Composite-girders, -columns, -slabs, -bridges Principles in composite constructions Bridge-design and -construction 	
Literature	Petersen, C.: Stahlbau, 4.Auflage 2013, Springer-Vieweg Verlag Minnert, J. Wagenknecht, G.: Verbundbau-Praxis - Berechnung und Konstruktion nach Eurocode 4, 2.Auflage 2013, Bauwerk Beuth Verlag	

Course L1205: Steel and Composite Structures	
Тур	Recitation Section (large)
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Marcus Rutner
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L1097: Steel Bridges	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Jörg Ahlgrimm
Language	DE
Cycle	WiSe
Content	Lecture Contents ,Steel Bridge Construction'
	Dring. Jorg Anigrimm
	- From tendering and contracting to completion - the development of a steel bridge
	- Contents of a bridge static - structural details, examples of analysis in detail:
	-> effective width in regard to the longitudinal stiffeners
	-> Bearing point, bearing stiffener
	-> Crossbeam breakthrough, crossbeam reinforcement
	-> Analysis of the Rib-to-Floorbeam (RF) connection (web-tooth of the floorbeam between trapezoidal shaped Ribs)
	- Steel grades, -designation, testing methods and approval certificates
	- Nondestructive weld inspecting
	- Corrosion protection
	- Bridge bearing - types, format, function, dimensioning, installation
	- Expansion Joints
	- Oscillation of bridge hangers and cables - oscillation damper
	- Opening bridges- Detailed reviews to different assembling procedures and - implements
	- Selective damage events
	Requirements: Basic knowledge in the calculation, dimensioning, and construction of structural elements and joints of constructional steelwork
Literature	
	Herbert Schmidt, Ulrich Schulte, Rainer Zwätz, Lothar Bär: Ausführung von Stahlbauten
	Petersen, Christian: Stahlbau, Abschnitt Brückenbau
	 Ahlgrimm, J., Lohrer, I.: Erneuerung der Eisenbahnüberführung in Fulda-Horas über die Fulda, Stahlbau 74 (2005), Heft 2, S. 114

Module M0969: Selected Topics in Civil Engineering Courses Title Тур Hrs/wk CP 2 Eraonomics (L0653) Lecture 3 Analysis of Offshore Structures (L1867) Lecture 1 1 Excellence in International Project Delivery (L2387) Integrated Lecture 2 2 Design of Prefabricated Concrete Structures (L0596) Lecture 1 1 Design of Prefabricated Concrete Structures (L0597) Recitation Section (large) 1 1 Forum I - Geotechnics and Construction Management (L1634) Seminar 1 1 Forum II - Geotechnics and Construction Management (L1635) Seminar 1 1 2 3 Geotechnical Engineering Design (L2447) Lecture Timber Structures (L1151) Seminar 2 2 Innovative Timber Construction (L2666) Lecture 2 3 Glass Structures (L1152) Lecture 2 2 Glass Structures (L1447) Recitation Section (large) 1 1 Testing and non-destructive examination of concrete members (L2725) Project-/problem-based Learning 2 2 Special topics of civil engineering 1CP (L2378) 1 1 Special topics of civil engineering 2 LP (L2379) 2 2 Special topics of civil engineering 3 LP (L2380) 3 3 Structural Design (L2789) Seminar 2 2 Module Responsible Prof. Frank Schmidt-Döhl **Admission Requirements** None **Recommended Previous** none Knowledge **Educational Objectives** After taking part successfully, students have reached the following learning results **Professional Competence** Knowledae • Students are able to find their way through selected special areas within civil and structural engineering. • Students are able to explain basic models and procedures in selected special areas of civil and structural engineering. Students are able to interrelate scientific and technical knowledge. Skills • Students are able to apply basic methods in selected areas of civil and structural engineering. **Personal Competence** Social Competence Autonomy • Students can chose independently, in which fields they want to deepen their knowledge and skills through the election of courses. Workload in Hours Depends on choice of courses **Credit points** 6 Assignment for the Civil Engineering: Specialisation Structural Engineering: Elective Compulsory **Following Curricula** Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory

Course L0653: Ergonomics	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and	30 min
scale	
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	

Module Manual M.Sc. "Civil Engineering"

Course L1867: Analysis of Of	ifshore Structures
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and	30 min
scale	
Lecturer	Dr. Said Fawad Mohammadi
Language	DE/EN
Cycle	SoSe
Content	Topic 1: Types of Offshore Structures, Fixed and floating structures for Oil & Gas and Offshore Wind industry
	Topic 2: Wave Forces, Morisons equation
	Topic 3: Irregular Seastates, Power spectrum and application of FFT
	Topic 4: Additional Environmental Forces, wind spectra, current forces
	Topic 5: Linear-Time-Invariant Systems, response of an LTI-system in frequency domain
	Topic 6: Tubular Welded Connections, stress concentration factors, weld geometry
	Topic 7: Introduction to Fracture Mechanics, criteria for fracture initiation and crack growth
	Topic 8: Time and Frequency Domain Fatigue Analyses, rainflow counting, application of LTI-systems for frequency domain fatigue
	Topic 9: Offshore Installation and Exam, installation of structures, pile driving, pipe laying techniques
Literature	Chakrabarti, Handbook of Offshore Engineering, 2005
	Sarpkaya, Wave Forces on Offshore Structures, 2010
	Faltinsen, Sea Loads on Ships and Offshore Structures, 1998
	Sorensen, Basic Coastal Engineering, 2006
	Dowling, Mechanical Behavior of Materials, 2007
	Haibach, Betriebsfestigkeit, 2006
	Marshall, Design of Welded Tubular Connections, 1992
	Newland, Random vibrations, spectral and wavelet analysis, 1993

Course L2387: Excellence in International Project Delivery	
Тур	Integrated Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	laut FSPO
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt
scale	
Lecturer	Dr. Jens Huckfeldt
Language	EN
Cycle	SoSe
Content	
Literature	

Course L0596: Design of Prefabricated Concrete Structures		
Тур	Lecture	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Examination Form	Klausur	
Examination duration and	60 min	
scale		
Lecturer	Prof. Günter Rombach	
Language	DE	
Cycle	SoSe	
Content	 application and advantages and disadvantages of precast concrete structures basics of design - precast element production - construction - tolerances elements of a warehouse design of a beam - joints design of D-regions: half joints, corbels, openings slab types - walls - facades footings: pocket and block foundations joints - connections shear design of the interface between concrete cast at different times unreinforced concrete structures 	
Literature	 Bachmann H., Steinle A.; Hahn V.: Bauen mit Betonfertigteilen. Betonkalender 2009, Teil I, Verlag Ernst & Sohn, Berlin Bindseil P.: Stahlbetonfertigteile. Werner Verlag, 1998 FIP: FIP Handbuch für Planung und Entwerfen von Fertigteilbauten (siehe Zeitschrift: Beton- und Fertigteiltechnik ab 3/1996) Bergmeister K.: Konstruieren von Fertigteilen. Betonkalender 2005 Teil 2, S. 163-240 Reineck KH.: Modellierung der D-Bereiche von Fertigteilen. Betonkalender 2005 Teil 2, S. 241-296 Graubner CA. et. al.: Bemessung von Fertigteilen nach DIN 1045-1. Betonkalender 2005 Teil 2, S. 297-374 Broschüren der Fachvereinigung Deutscher Betonfertigteilbau e.V. siehe: www.fdb-fertigteilbau.de www.systembauweise.de 	

Course L0597: Design of Prefabricated Concrete Structures	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and	Siehe korrespondierende Vorlesung
scale	
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L1634: Forum I - Geotechnics and Construction Management	
Тур	Seminar
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and	30 min
scale	
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	Lectures about projects and issues with practical and scientific relevance.
Literature	

Course L1635: Forum II - Geotechnics and Construction Management	
Тур	Seminar
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and	30 min
scale	
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	SoSe
Content	Lectures about projects and issues with practical and scientific relevance.
Literature	

Course L2447: Geotechnical	Engineering Design
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and	45 Min.
scale	
Lecturer	Prof. Jürgen Grabe, Dr. Tim Pucker
Language	DE
Cycle	WiSe
Content	The focus of the course is on the design of geotechnical structures. Methods and fundamental approaches for the successful processing of geotechnical designs are taught. Theoretical approaches are backed up with examples from everyday work in industry. In parallel to the theoretical content, students are given a practical task for a geotechnical design at beginning of the course, which will be worked on in small teams. In addition to the application of the already acquired technical knowledge, topics like realisation, construction sequence planning, cost calculation, optimisation and evaluation criteria are also part of the course. The event will be finished with the presentation of the designs.
Literature	

Course L1151: Timber Structures	
Тур	Seminar
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Referat
Examination duration and	90 min
scale	
Lecturer	Prof. Torsten Faber
Language	DE
Cycle	WiSe
Content	
Literature	

Course L2666: Innovative Timber Construction	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and	45 Minuten
scale	
Lecturer	Dr. Andreas Meisel
Language	DE
Cycle	WiSe
Content	
Literature	- Blass, J.: "Ingenieurholzbau"
	- Schickhofer, G.: "BSPhandbuch: Holz-Massivbauweise in Brettsperrholz"
	- Informationsdienst Holz: div. Merkblätter und Broschüren
	- Wallner-Novak M.: Brettsperrholz Bemessung, Band 1 und 2
	- Gerner M.: "Fachwerk: Entwicklung, Instandsetzung, Neubau"
	- Meisel, A.: "Historische Dachwerke: Beurteilung, realitätsnahe statische Analyse und Instandsetzung"
	- Kempe K.: "Dokumentation Holzschädlinge"
	- Huckfeldt T.: "Hausfäule- und Bauholzpilze"

Course L1152: Glass Structures		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	Mündliche Prüfung	
Examination duration and		
scale		
Lecturer	Marvin Matzik	
Language	DE	
Cycle	WiSe	
Content	Glass structures	
	- Introduction of the material glass (production, refinement, material characteristic)	
	- design of facades	
	- facade types	
	- static calculation of glazing	
	- static calculation of facades	
	- load bearing behavior of glazing (plate or membrane stiffness)	
	- vertical / horizontal glazing with safety-related requirements	
	- glass structures	
	- fire safety of glass facades	
	- construction physics of facades and glazing	
Literature		

Course L1447: Glass Structures	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Mündliche Prüfung
Examination duration and	
scale	
Lecturer	Marvin Matzik
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L2725: Testing and non-destructive examination of concrete members	
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and	20 min
scale	
Lecturer	Dr. Lukas Henze, Dr. Lukas Henze
Language	DE
Cycle	SoSe
Content	
Literature	

Course L2378: Special topics of civil engineering 1CP	
Тур	
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	laut FSPO
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt
scale	
Lecturer	Dozenten des SD B
Language	DE
Cycle	WiSe/SoSe
Content	The course occurs only if required. The content is defined at short notice.
Literature	Die Literatur wird kurzfristig festgelegt.

Course L2379: Special topics of civil engineering 2 LP	
Тур	
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	laut FSPO
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt
scale	
Lecturer	Dozenten des SD B
Language	DE
Cycle	WiSe/SoSe
Content	The course occurs only if required. The content is defined at short notice.
Literature	Die Literatur wird kurzfristig festgelegt.

Course L2380: Special topics of civil engineering 3 LP	
Тур	
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	laut FSPO
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt
scale	
Lecturer	Dozenten des SD B
Language	DE
Cycle	WiSe/SoSe
Content	The course occurs only if required. The content is defined at short notice.
Literature	Die Literatur wird kurzfristig festgelegt.

Module Manual M.Sc. "Civil Engineering"

Course L2789: Structural Design		
Тур	Seminar	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	Mündliche Prüfung	
Examination duration and	20 min	
scale		
Lecturer	Dr. Jan Mittelstädt	
Language	DE/EN	
Cycle	SoSe	
Content		
Literature	[1] Structure Systems by Heino Engel, Hantje Cantz, 3rd edition (Feb 2007), ISBN-10: 3775718761	
	Form and Force, Designing Efficient, Expressive Structures by Allan, E., Zalewski, W. et al, John Wiley and	
	Sons; 1st edition (Sept 2009), ISBN-10: 047017465X	
	[2] Peter Rice: An Engineer Imagines, ISBN-10 : 1849944237	
	[3] Konrad Wachsmann and the Grapevine Structure by C. Sumi et al., Park Books (Oct 2018), ISBN-10:	
	9783038601104	
	[4] Manual of Multi-Story Timber Construction by Hermann Kaufmann, Stefan Krotsch, Stefan Winter, DETAIL,	
	(June 2018), ISBN-10: 3955533948	
	[5] The Art of Structural Design: A Swiss Legacy by B. Billington, Princeton University Art Museum; First Edition	
	edition (Mar 2003), ISBN-10: 0300097867	
	[6] Structured Lineages: Learning from Japanese Structural Design by G. Nordenson et al, The Museum of	
	Modern Art (Jul 2019), ISBN-10: 1633450562	
	[7] The Structure: Works of Mahendra Raj by V. Mehta, R. Mehndiretta, A. Huber, Park Books (Oct 2015),	
	ISBN-10: 3038600253	

Module M0699: Geote	echnics III			
Courses				
Title		Тур	Hrs/wk	СР
Numerical Methods in Geotechnics	(L0375)	Lecture	3	3
Advanced Foundation Engineering	(L0497)	Lecture	2	2
Advanced Foundation Engineering	(L0498)	Recitation Section (large)	1	1
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lectu	ure 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engir	eering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Er	igineering: Compulsory		
	Civil Engineering: Specialisation Coastal Enginee	ring: Compulsory		
	Civil Engineering: Specialisation Water and Traff	ic: Elective Compulsory		
	International Management and Engineering: Spe	cialisation II. Civil Engineering: Elective Com	oulsory	
L		· ·	-	

Course L0375: Numerical Methods in Geotechnics	
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Dr. Hans Mathäus Stanford
Language	DE
Cycle	WiSe
Content	Topics: • numerical simulations • numerical algorithms • finite element method • application of finite element method in geomechanics • constitutive models for soils • contact models for soil structure interaction • selected applications
Literature	 Wriggers P. (2001): Nichtlineare Finite-Elemente-Methoden, Springer Verlag, Berlin Bathe Klaus-Jürgen (2002): Finite-Elemente-Methoden. Springer Verlag, Berlin

Course L0497: Advanced Foundation Engineering	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	 Vertical drains Piles Ground improvement (Deep Compaction, Soil mixing) Vibration driving Jet grouting Slurry wall Deep excavation
Literature	 EAK (2002): Empfehlungen für Küstenschutzbauwerke EAU (2004): Empfehlungen des Arbeitsausschusses Uferbauwerke EAB (1988): Empfehlungen des Arbeitskreises Baugruben Grundbau-Taschenbuch, Teil 1-3, (1997), Ernst & Sohn Verlag

Course L0498: Advanced Foundation Engineering	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Module M1401: Study	y work Water and Traffic
Courses	
Title	Typ Hrs/wk CP
Module Responsible	Dozenten des SD B
Admission Requirements	None
Recommended Previous	Subjects of the Water Management and Waste specialisation.
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students are able to demonstrate their detailed knowledge in the field of water management and waste. They can exemplif the state of technology and application and discuss critically in the context of actual problems and general conditions of science and society. The students can develop solving strategies and approaches for fundamental and practical problems in the field of water
	management and waste. They may apply theory based procedures and integrate safety-related, ecological, ethical, and econom view points of science and society. Scientific work techniques that are used can be described and critically reviewed.
Skills	The students are able to independently select methods or planning approaches for the project work and to justify their choice. They can explain how these methods or approaches relate to solutions in the field of work and how the context of application has to be adjusted. General findings and further developments may essentially be outlined.
Personal Competence	
Social Competence	The students are able to condense the relevance and the structure of the project work, the work steps and the sub-problems for the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to the colleagues.
Autonomy	The students are capable of independently planning and documenting the work steps and procedures while considering the give deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain feedbac from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology.
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0
Credit points	6
Course achievement	None
Examination	Study work
Examination duration and	See FSPO
scale	
Assignment for the Following Curricula	Civil Engineering: Specialisation Water and Traffic: Compulsory

Module M0802: Mem	orane Technology			
Courses				
Title		Тур	Hrs/wk	СР
Membrane Technology (L0399)		Lecture	2	3
Membrane Technology (L0400)		Recitation Section (small)	1	2
Membrane Technology (L0401)		Practical Course	1	1
Module Responsible	Prof. Mathias Ernst			
Admission Requirements	None			
Recommended Previous	Basic knowledge of water chemistry. Knowledge of the c	core processes involved in water, gas ar	nd steam treatr	ment
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	Students will be able to rank the technical applications	of industrially important membrane pro	cesses. They v	vill be able to explain
	the different driving forces behind existing membrane	e separation processes. Students will	pe able to nan	ne materials used in
	membrane filtration and their advantages and disadva	ntages. Students will be able to expla	in the key diffe	erences in the use of
	membranes in water, other liquid media, gases and in light	quid/gas mixtures.		
Skills	Students will be able to prepare mathematical equation	ns for material transport in porous and	d solution-diffu	sion membranes and
	calculate key parameters in the membrane separation	process. They will be able to handle te	chnical memb	rane processes using
	available boundary data and provide recommendation	is for the sequence of different treatm	nent processes	. Through their own
	experiments, students will be able to classify the se	paration efficiency, filtration characte	ristics and ap	plication of different
	membrane materials. Students will be able to character	ise the formation of the fouling layer in	different water	s and apply technical
	measures to control this.			
Personal Competence			-	
Social Competence	Students will be able to work in diverse teams on tasks	In the field of membrane technology.	iney will be ab	le to make decisions
	within their group on laboratory experiments to be unde	reaken jointly and present these to othe	215.	
Autonomy	Students will be in a position to solve homework on the	he topic of membrane technology inde	ependently. The	ey will be capable of
	finding creative solutions to technical questions.			
Workload in Hours	Independent Study Time 124. Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Water and Traffic: Elect	ive Compulsory		
Following Curricula	Bioprocess Engineering: Specialisation A - General Biopr	rocess Engineering: Elective Compulsor	/	
3 1 1	Bioprocess Engineering: Specialisation B - Industrial Bio	process Engineering: Elective Compulso	, iry	
	Chemical and Bioprocess Engineering: Specialisation Ch	emical Process Engineering: Elective Co	ompulsory	
	Chemical and Bioprocess Engineering: Specialisation Ge	neral Process Engineering: Elective Cor	npulsory	
	Energy and Environmental Engineering: Specialisation E	nergy and Environmental Engineering:	Elective Compu	ulsory
	Environmental Engineering: Specialisation Water: Electiv	ve Compulsory		
	Joint European Master in Environmental Studies - Cities	and Sustainability: Specialisation Water	: Elective Com	oulsory
	Process Engineering: Specialisation Process Engineering	: Elective Compulsory		
	Process Engineering: Specialisation Environmental Proce	ess Engineering: Elective Compulsory		
	Water and Environmental Engineering: Specialisation W	ater: Elective Compulsory		
	Water and Environmental Engineering: Specialisation En	vironment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Ci	ties: Elective Compulsory		

Course L0399: Membrane Technology		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Mathias Ernst	
Language	EN	
Cycle	WiSe	
Content	The lecture on membrane technology supply provides students with a broad understanding of existing membrane treatment processes, encompassing pressure driven membrane processes, membrane application in electrodialyis, pervaporation as well as membrane distillation. The lectures main focus is the industrial production of drinking water like particle separation or desalination; however gas separation processes as well as specific wastewater oriented applications such as membrane bioreactor systems will be discussed as well. Initially, basics in low pressure and high pressure membrane applications are presented (microfiltration, ultrafiltration, nanofiltration, reverse osmosis). Students learn about essential water quality parameter, transport equations and key parameter for pore membrane as well as solution diffusion membrane systems. The lecture sets a specific focus on fouling and scaling issues and provides knowledge on methods how to tackle with these phenomena in real water treatment application. A further part of the lecture deals with the character and manufacturing of different membrane materials and the characterization of membrane material by simple methods and advanced analysis. The functions, advantages and drawbacks of different membrane housings and modules are explained. Students learn how an industrial membrane application is designed in the succession of treatment steps like pre-treatment, water conditioning, membrane integration and post-treatment of water. Besides theory, the students will be provided with knowledge on membrane demo-site examples and insights in industrial practice.	
Literature	 T. Melin, R. Rautenbach: Membranverfahren: Grundlagen der Modul- und Anlagenauslegung (2., erweiterte Auflage), Springer-Verlag, Berlin 2004. Marcel Mulder, Basic Principles of Membrane Technology, Kluwer Academic Publishers, Dordrecht, The Netherlands Richard W. Baker, Membrane Technology and Applications, Second Edition, John Wiley & Sons, Ltd., 2004 	

Course L0400: Membrane Technology	
Тур	Recitation Section (small)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Mathias Ernst
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L0401: Membrane Technology	
Тур	Practical Course
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Mathias Ernst
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Courses				
Title		Тур	Hrs/wk	СР
Practical Course in Water and Wast	ewater Technology I (L0503)	Practical Course	2	3
Practicle Course of Wastewater Tec	hnology II (L0607)	Practical Course	3	3
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
Recommended Previous	Basic knowledge in chemistry and physic	s (knowledge acquired at school)		
Knowledge				
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge	The students know basic analytical procedures for evaluating the quality of water and wastewater. They have knowledge about			
	fundamental process engineering feature	es of important water and wastewater treatment	technologies.	
Skills	The students are able to understand ar	nd to practically apply methodologies for waste	water analysis as we	ell as descriptions of
	experiments and experimental setups in	wastewater technology.		
Personal Competence				
Social Competence				
Autonomy	The students are able to conduct experin	nents following written procedures without exter	nal assistance.	
Workload in Hours	Independent Study Time 110, Study Time	e in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	ca. 5 Stunden			
scale				
Assignment for the	Civil Engineering: Specialisation Water a	nd Traffic: Elective Compulsory		
Following Curricula	Water and Environmental Engineering: S	pecialisation Water: Elective Compulsory		
	Water and Environmental Engineering: S	pecialisation Environment: Elective Compulsory		
	Water and Environmental Engineering, S	nanialization Citizat Elective Commulater		

Course L0503: Practical Course in Water and Wastewater Technology I	
Тур	Practical Course
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Dorothea Rechtenbach
Language	EN
Cycle	WiSe
Content	- Impact of pretreatment of wastewater samples on analytical results
	- Analysis of nutrients in wastewater samples (different methods for nitrate analysis) - Alkalinity
	- TOC, COD
	- microscopic analysis of microorganisms relevant in wastewater treatment
Literature	Skript auf StudIP

Course L0607: Practicle Course of Wastewater Technology II	
Тур	Practical Course
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Dr. Joachim Behrendt
Language	DE/EN
Cycle	WiSe
Content	Experiments:
	Oxygen transfer
	Oxygen Uptake rate
	Sludge dewatering
	Tracer
	Flocculation
Literature	Skript/Script

Module M0581: Wate	r Protection			
Courses				
Title		Тур	Hrs/wk	СР
Water Protection and Wastewater	lanagement (L0226)	Lecture	3	3
Water Protection and Wastewater N	Aanagement (L2008)	Project Seminar	3	3
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous	 Basic knowledge in water management; 			
Knowledge	 Good knowledge in urban drainage; 			
	 Good knowledge of wastewater treatment 	nt techniques;		
	 Good knowledge of pollutants (e.g. COD, 	BOD, TS, N, P) and their properties;		
Educational Objectives	After taking part successfully, students have re	ached the following learning results		
Professional Competence				
Knowledge	The students can describe the basic principles	of the regulatory framework related to the	international and Eu	ropean water sector.
	They can explain limnological processes, sub	stance cycles and water morphology in d	etail. They are able	e to assess complex
	problems related to water protection, such as	ecosystem service and wastewater treat	ment with a special	focus on innovative
	solutions, remediation measures as well as con	ceptual approaches.		
Skills	Students can accurately assess current proble	ms and situations in a country-specific or l	ocal context. They o	an suggest concrete
	actions to contribute to the planning of tom	orrow's urban water cycle. Furthermore, t	hey can suggest a	opropriate technical,
	administrative and legislative solutions to solve	e these problems.		
Personal Competence				
Social Competence	The students can work together in internationa	l groups.		
Autonomy	Students are able to organize their work flow	to prepare presentations and discussions.	They can acquire ap	propriate knowledge
	by making enquiries independently.			
Workload in Hours	Independent Study Time 96, Study Time in Lec	ture 84		
Credit points	6			
Course achievement	None			
Examination	Presentation			
Examination duration and	Term paper plus presentation			
scale				
Assianment for the	Civil Engineering: Specialisation Structural Engi	ineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical E	ngineering: Elective Compulsory		
-	Civil Engineering: Specialisation Coastal Engine	ering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Tra	ffic: Elective Compulsory		
	Environmental Engineering: Specialisation Wate	er: Elective Compulsory		
	International Management and Engineering: Sp	ecialisation II. Civil Engineering: Elective Co	mpulsory	
	Joint European Master in Environmental Studies	s - Cities and Sustainability: Specialisation V	Vater: Elective Comp	oulsory
	water and Environmental Engineering: Special	sation Cities: Elective Compulsory		
	Water and Environmental Engineering: Special	sation Environment: Compulsory		

Course L0226: Water Protect	tion and Wastewater Management
Тур	Lecture
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	WiSe
Content	 The lecture focusses on: Regulatory Framework (e.g. WFD) Main instruments for the water management and protection In depth knowledge of relevant measures of water pollution control Urban drainage, treatment options in different regions on the world Rainwater management, improved management of heavy rainfalls, downpours, rainwater harvesting, rainwater infiltration Case Studies and Field Trips
Literature	 The literature listed below is available in the library of the TUHH. Water and wastewater technology Hammer, M. J. 1., & . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Education International. Water and wastewater engineering : design principles and practice: Davis, M. L. 1. (2011) New York, NY: McGraw-Hill. Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ.

Course L2008: Water Protection and Wastewater Management	
Тур	Project Seminar
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	WiSe
Content	
Literature	

Module M1725: Scien	tific Working in Computational Engi	neering			
Courses					
Title		Тур	Hrs/wk	СР	
Scientific Working in Computationa	I Engineering (L2764)	Project-/problem-based Learning	4	6	
Module Responsible	Prof. Kay Smarsly				
Admission Requirements	None				
Recommended Previous	Basic knowledge in scientific writing. String interest in topics related to computing in civil engineering.				
Knowledge					
Educational Objectives	After taking part successfully, students have reache	d the following learning results			
Professional Competence					
Knowledge	course instructors and in collaboration with each other, the students will also learn to understand the complex process of scientific thinking, being able to accurately plan, implement and analyze scientific projects, such as prospective master theses. Since scientific writing is of particular importance in this course, a scientific paper will be developed, which is a prerequisite for the final examination. The paper will be written based on a project to be conducted within this course. Project meetings in small groups, presentations, and critical discussions of scientific publications are further key activities.				
Skills					
Personal Competence					
Social Competence					
Autonomy					
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56			
Credit points	6				
Course achievement	None				
Examination	Written elaboration				
Examination duration and	10 pages of work with 15-minute oral presentation				
scale					
Assignment for the	Civil Engineering: Specialisation Water and Traffic: E	lective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engine	eering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineering	g: Elective Compulsory			
	Civil Engineering: Specialisation Structural Engineer	ing: Elective Compulsory			

Course L2764: Scientific Working in Computational Engineering			
Тур	Project-/problem-based Learning		
Hrs/wk	4		
СР	6		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Lecturer	Prof. Kay Smarsly		
Language	EN		
Cycle	WiSe/SoSe		
Content	In the course, a scientific problem of practical relevance will first be defined, taking into account the interests of the students		
	participating in the course. The scientific problem will then systematically be solved within the framework of a comprehensive		
	project. The principles of scientific working will be taught based on the scientific problem defined previously. As an integral part of		
	scientific working, fundamentals of scientific writing will be presented and applied to a scientific paper to be written during the		
	course. Topics related to scientific writing include structuring in scientific writing (structuring the abstract, the introduction, the		
	main part, the summary and conclusions, and the acknowledgments and references) and recommendations on effective scientific		
	writing (principles of composition, use of English in scientific writing, useful tips, creating figures, writing in mathematics,		
	referencing, and formal email correspondence). A final paper and a final presentation will be assembled by the students.		
Literature			

Module M1505: Adap	tation	to Climate	Change i	in Hydrau	ulic Engin	eering (AK\	NAS)		
Courses									
Title Adaptation to climate change in hydraulic engineering (L2291)					Typ Project-/problem-	based Learning	Hrs/wk	CP 6	
Module Responsible	Prof. Pet	er Fröhle							
Admission Requirements	None								
Recommended Previous Knowledge	• Hy • Hy • Fu • Fu	ydrology, Hydra ydromechanic, ł undamentals of ydrological Syst	ulic Engineeri Hydraulics Coastal Engin ems	ing neering, Coast	tal- and Flood	Protection			
Educational Objectives	After tak	king part succes	sfully, student	ts have reach	ed the followi	ng learning resul	ts		
Professional Competence	1								
Knowledge Skills	 CI In: In: Fu Cc Mi As Fu Cr Cr Cr Pr m Cc 	limate protectio sights into climat undamentals of onsequences of easures for clim ssessment, prior undamentals of ritical thinking: a reative thinking: ractical thinking ethods onsideration of o	n and climate ate change an e change on t analysis of clii the impact of late adaptatio ritization and the analysis of analysis of pro- c development production of complex tasks	e adaptation nd its regional the componen imate data f the climate o on communicatio of hydrometeo ocesses and r at of adaptatio f restrictions, s	l characteristic nts of the regio change on of adaptati prological and relations, asse on strategies a , application o	cs - fundamental: onal hydrological on measures hydrological data ssment of needs nd adaptation m of calculation ap	s, climate mode cycle a for action easures proaches, meth	lling / climate	e models cal models, plann
Personal Competence									
Social Competence	,								
	• W • W • Se	/orking in heterc /orking with diffe elf reflection	ogenous group erent scientific	ps ic / non-scient	ific disciplines				
Autonomy	· .								
	• Ap	utonomous work	ed use of kno	wieage and s	KIIIS				
	• AL	utonomous won	con complex	LdSKS					
Workload in Hours	Independ	dent Study Time	e 124, Study T	Time in Lectur	re 56				
Credit points	6								
Course achievement	None								
Examination	Written e	elaboration							
Examination duration and	l Preparat	tion of a written	report and a p	presentation	of a complex t	ask.			
scale	1								
Assignment for the	Civil Eng	jineering: Specia	alisation Coast	stal Engineerir	ng: Elective Co	ompulsory			
Following Curricula	Civil Eng	jineering: Specia	alisation Geote	echnical Engi	neering: Elect	ive Compulsory			
	Civil Eng	jineering: Specia	alisation Struc	ctural Enginee	ering: Elective	Compulsory			
	Civil Eng	ineering: Specia	alisation Wate	er and Traffic:	Elective Com	pulsory			
	Water ar	nd Environment	al Engineering	g: Specialisati	ion Cities: Elec	tive Compulsory			
	Water ar	na Environment	ai Engineering	g: Specialisati	ion Environme	nt: Elective Com	pulsory		
	water ar	nu Environment	ai Engineering	y: specialisati	ion water: Ele	cuve compulsory	r		

Course L2291: Adaptation to	climate change in hydraulic engineering		
Тур	Project-/problem-based Learning		
Hrs/wk	4		
СР	6		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Lecturer	Prof. Peter Fröhle		
Language	DE		
Cycle	WiSe		
Content	 Climate protection and climate adaptation Findings on climate change and its regional characteristics: fundamentals of climate change, climate modelling / climate models Impacts of climate change on the components of the regional hydrological cycle(climate science view) Fundamentals of the analysis of climate data Concequences of the impacts of climate change (ingenieering science view) Measures for climate change adaptation Assessment, prioritization and communication of measures Fundamentals of analysis of hydrometeorological and hydrological data 		
Literature	Bereitgestellte eLearning Plattform		

Module M1717: Adva	nced Vadose Zone Hydrology				
Courses					
Title		Typ	Hrs/wk	CP	
Modeling Processes in Vadose Zon	e (I 2734)	i yp	1	1	
Modeling Processes in Vadose Zon	e (12735)	Becitation Section (small)	1	1	
Vadose Zone Hydrology (L2732)		Lecture	2	2	
Vadose Zone Hydrology (L2733)		Recitation Section (large)	2	2	
Module Responsible	Prof. Nima Shokri				
Admission Requirements	None				
Recommended Previous					
Knowledge					
Educational Objectives	After taking part successfully, students have re	After taking part successfully, students have reached the following learning results			
Professional Competence					
Knowledge					
Skills					
Personal Competence					
Social Competence					
Autonomy					
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84				
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	90 min				
scale					
Assignment for the	Civil Engineering: Specialisation Water and Tra	ffic: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Water and Tra	ffic: Elective Compulsory			
	Environmental Engineering: Specialisation Wat	er: Elective Compulsory			
	Environmental Engineering: Specialisation Wat	er: Elective Compulsory			
	Water and Environmental Engineering: Special	sation Water: Elective Compulsory			
	Water and Environmental Engineering: Specialisation Environment: Elective Compulsory				
	Water and Environmental Engineering: Specialisation Cities: Elective Compulsory				
	Water and Environmental Engineering: Special	sation Cities: Elective Compulsory			
	Water and Environmental Engineering: Special	sation Environment: Elective Compulsory			
	Water and Environmental Engineering: Special	sation Water: Elective Compulsory			

Course L2734: Modeling Processes in Vadose Zone		
Тур	Lecture	
Hrs/wk	1	
CP	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Hannes Nevermann, Prof. Nima Shokri	
Language	EN	
Cycle	SoSe	
Content		
Literature		

Course L2735: Modeling Processes in Vadose Zone		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Hannes Nevermann	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	
Course L2732: Vadose Zone Hydrology		
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Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Nima Shokri	
Language	EN	
Cycle	SoSe	
Content		
Literature		

Course L2733: Vadose Zone Hydrology	
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Nima Shokri
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1718: Multi	phase Flow in Porous Media			
Courses				
Title		Тур	Hrs/wk	СР
Advanced Modeling Techniques for	Multiphase Flow in Porous Media (L2738)	Recitation Section (small)	2	2
Fundamentals of Multiphase Flow in	n Porous Media (L2736)	Lecture	2	2
Fundamentals of Multiphase Flow in	n Porous Media (L2737)	Recitation Section (large)	2	2
Module Responsible	Prof. Nima Shokri			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached	I the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Water and Traffic: El	ective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engine	ering: Elective Compulsory		
	Civil Engineering: Specialisation Geotechnical Engine	ering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: El	ective Compulsory		
	Environmental Engineering: Specialisation Water: Ele	ctive Compulsory		
	Environmental Engineering: Specialisation Water: Ele	ctive Compulsory		
	Water and Environmental Engineering: Specialisation	Cities: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Cities: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Water: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Water: Elective Compulsory		

Course L2738: Advanced Modeling Techniques for Multiphase Flow in Porous Media	
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Nima Shokri
Language	EN
Cycle	SoSe
Content	
Literature	

Course L2736: Fundamentals of Multiphase Flow in Porous Media	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Nima Shokri
Language	EN
Cycle	SoSe
Content	
Literature	

Course L2737: Fundamentals of Multiphase Flow in Porous Media	
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Hannes Nevermann
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M1721: Wate	and Environment: Theory and Appli	cation		
Courses				
Title		Тур	Hrs/wk	СР
Water and Environment: Applicatio	and Field Work (L2754)	Project-/problem-based Learning	3	4
Water and Environment: Theory (L	753)	Lecture	1	2
Module Responsible	Prof. Nima Shokri			
Admission Requirements	None			
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	6		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Report (about 5-10 pages) and Presentation (about 15	min)		
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: I	Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Water and Traffic: Ele	ctive Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: I	Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Ele	ctive Compulsory		
	Environmental Engineering: Specialisation Water: Elec	tive Compulsory		
	Environmental Engineering: Specialisation Water: Elec	tive Compulsory		
	Water and Environmental Engineering: Specialisation	Cities: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Cities: Elective Compulsory		
	Water and Environmental Engineering: Specialisation I	Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation I	Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	Water: Elective Compulsory		
	water and Environmental Engineering: Specialisation	water: Elective Compulsory		

Course L2754: Water and Environment: Application and Field Work	
Тур	Project-/problem-based Learning
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Anna Luisa Hemshorn de Sánchez, Dr. Salome Shokri-Kuehni
Language	EN
Cycle	SoSe
Content	
Literature	

Course L2753: Water and Environment: Theory	
Тур	Lecture
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Nima Shokri
Language	EN
Cycle	SoSe
Content	
Literature	

Module M1724: Smar	t Monitoring			
Courses				
Title		Тур	Hrs/wk	СР
Smart Monitoring (L2762)		Integrated Lecture	2	2
Smart Monitoring (L2763)		Recitation Section (small)	2	4
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None			
Recommended Previous	Basic knowledge or interest in object-oriented modeling, p	programming, and sensor technol	ogies are helpfu	I. Interest in moderr
Knowledge	research and teaching areas, such as Internet of Things, I	ndustry 4.0 and cyber-physical sy	/stems, as well a	as the will to deepen
	skills of scientific working, are required. Basic knowledge in	scientific writing and good English	ı skills.	
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
Professional Competence				
Knowledge	The students will become familiar with the principles and	d practices of smart monitoring.	The students w	ill be able to design
	decentralized smart systems to be applied for continuo	us (remote) monitoring of syste	ems in the built	and in the natural
	environment. In addition, the students will learn to design a	and to implement intelligent sense	or systems using	state-of-the-art data
	analysis techniques, modern software design concepts, and	embedded computing methodolo	gies. Besides lec	tures, project work is
	also part of this module. In small groups, the students	will design smart monitoring s	ystems that int	egrate a number of
	"intelligent" sensors to be implemented by the students	5. Specific focus will be put on	the application	of machine learning
	techniques. The smart monitoring systems will be mounted	l on real-world (built or natural) s	ystems, such as	bridges or slopes, or
	on scaled lab structures for validation purposes. The outco	me of every group will be docum	ented in a pape	r. All students of this
	module will "automatically" participate with their smart n	nonitoring system in the annual	"Smart Monitorii	ng" competition. The
	written papers and oral examinations form the final grades.	The module will be taught in Engl	ish. Limited enro	ollment.
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	10 pages of work with 15-minute oral presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Water and Traffic: Elective	Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: I	Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Electiv	ve Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Elec	ctive Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Electiv	ve Compulsory		
	Civil Engineering: Specialisation Geotechnical Engineering: I	Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Elec	Compulsory		
	Environmental Engineering: Specialisation Water and Traffic: Elective			
	Environmental Engineering: Specialisation Waste and Energ			
	Environmental Engineering: Specialisation Differentiology. E	iompulsory		
	Environmental Engineering: Specialisation Water: Elective e	v. Elective Compulsory		
	Environmental Engineering: Specialisation Biotechnology: E	lective Compulsory		
	Environmental Engineering: Specialisation Water: Elective C	Compulsory		
	Water and Environmental Engineering: Specialisation Cities:	Elective Compulsory		
	Water and Environmental Engineering: Specialisation Cities:	Elective Compulsory		
	Water and Environmental Engineering: Specialisation Enviro	onment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Enviro	onment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Water	: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Water	: Elective Compulsory		

Course L2762: Smart Monito	ring
Тур	Integrated Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Kay Smarsly
Language	EN
Cycle	WiSe/SoSe
Content	In this course, principles of smart monitoring will be taught, focusing on modern concepts of data acquisition, data storage, and data analysis. Also, fundamentals of intelligent sensors and embedded computing will be illuminated. Autonomous software and decentralized data processing are further crucial parts of the course, including concepts of the Internet of Things, Industry 4.0 and cyber-physical systems. Furthermore, measuring principles, data acquisition systems, data management and data analysis algorithms will be discussed. Besides the theoretical background, numerous practical examples will be shown to demonstrate how smart monitoring may advantageously be used for assessing the condition of systems in the built or natural environment.
Literature	

Course L2763: Smart Monito	ring
Тур	Recitation Section (small)
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Kay Smarsly
Language	EN
Cycle	WiSe/SoSe
Content	The contents of the exercises are based on the lecture contents. In addition to the exercises, project work will be conducted, which will consume the majority of the workload. As part of the project work, students will design smart monitoring systems that will be tested in the laboratory or in the field. As mentioned in the module description, the students will participate in the "Smart Monitoring" competition, hosted annually by the Institute of Digital and Autonomous Construction. Students are encouraged to contribute their own ideas. The tools required to implement the smart monitoring systems will be taught in the group exercises as well as through external sources, such as video tutorials and literature.
Literature	

	Thesis	
Module M-002: Master Thesis		
Courses		
Title	Typ Hrs/wk CP	
Module Responsible	Professoren der TUHH	
Admission Requirements	According to General Regulations §21 (1):	
	At least 60 credit points have to be achieved in study programme. The examinations board decides on exceptions.	
Recommended Previous Knowledge		
Educational Objectives	After taking part successfully, students have reached the following learning results	
Knowledge	 The students can use specialized knowledge (facts, theories, and methods) of their subject competently on specialized issues. The students can explain in depth the relevant approaches and terminologies in one or more areas of their subject, describing current developments and taking up a critical position on them. The students can place a research task in their subject area in its context and describe and critically assess the state of research. 	
Skills	 The students are able: To select, apply and, if necessary, develop further methods that are suitable for solving the specialized problem in question. To apply knowledge they have acquired and methods they have learnt in the course of their studies to complex and/or incompletely defined problems in a solution-oriented way. To develop new scientific findings in their subject area and subject them to a critical assessment. 	
Personal Competence		
Social Competence	Students can	
	 Both in writing and orally outline a scientific issue for an expert audience accurately, understandably and in a structured way. Deal with issues competently in an expert discussion and answer them in a manner that is appropriate to the addressees while upholding their own assessments and viewpoints convincingly. 	
Autonomy	Students are able:	
	 To structure a project of their own in work packages and to work them off accordingly. To work their way in depth into a largely unknown subject and to access the information required for them to do so. To apply the techniques of scientific work comprehensively in research of their own. 	
Workload in Hours	Independent Study Time 900, Study Time in Lecture 0	
Credit points	30	
Course achievement	None	
Examination	Thesis	
Examination duration and	According to General Regulations	
scale	Civil Engineering: Thesis: Computern:	
Following Curricula	Bioprocess Engineering: Thesis: Compulsory Chemical and Bioprocess Engineering: Thesis: Compulsory Computer Science: Thesis: Compulsory Electrical Engineering: Thesis: Compulsory Energy and Environmental Engineering: Thesis: Compulsory Energy Systems: Thesis: Compulsory	
	Environmental Engineering: Thesis: Compulsory Aircraft Systems Engineering: Thesis: Compulsory Global Innovation Management: Thesis: Compulsory Computational Science and Engineering: Thesis: Compulsory Information and Communication Systems: Thesis: Compulsory Interdisciplinary Mathematics: Thesis: Compulsory International Management and Engineering: Thesis: Compulsory Joint European Master in Environmental Studies - Cities and Sustainability: Thesis: Compulsory Logistics, Infrastructure and Mobility: Thesis: Compulsory Materials Science: Thesis: Compulsory Mechanical Engineering and Management: Thesis: Compulsory	

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	Mechatronics: Thesis: Compulsory
	Biomedical Engineering: Thesis: Compulsory
	Microelectronics and Microsystems: Thesis: Compulsory
	Product Development, Materials and Production: Thesis: Compulsory
	Renewable Energies: Thesis: Compulsory
	Naval Architecture and Ocean Engineering: Thesis: Compulsory
	Ship and Offshore Technology: Thesis: Compulsory
	Teilstudiengang Lehramt Metalltechnik: Thesis: Compulsory
	Theoretical Mechanical Engineering: Thesis: Compulsory
	Process Engineering: Thesis: Compulsory
	Water and Environmental Engineering: Thesis: Compulsory
	L <u>Certification in Engineering & Advisory in Aviation: Thesis: Compulsory</u>